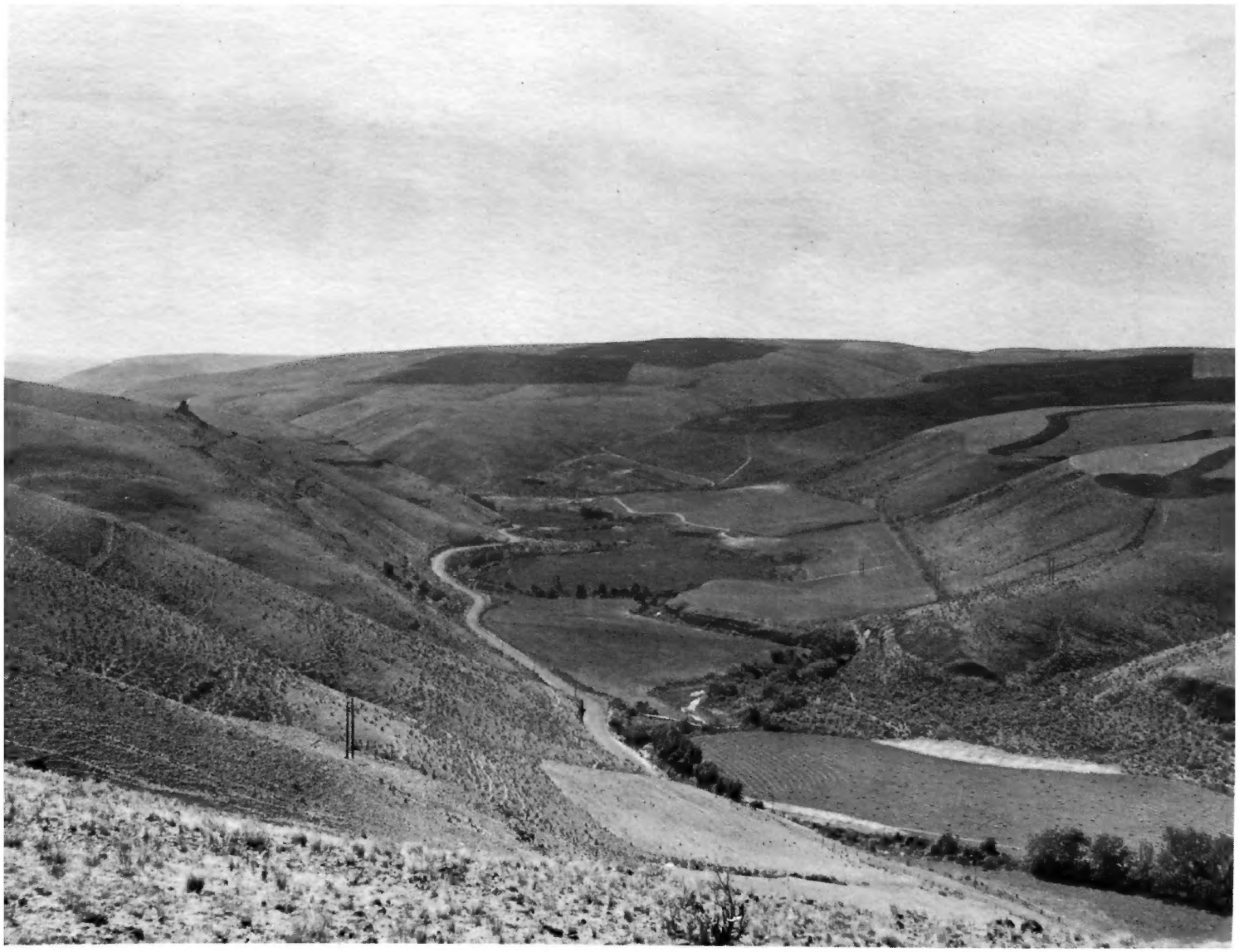
United States
Department of
Agriculture

Soil
Conservation
Service

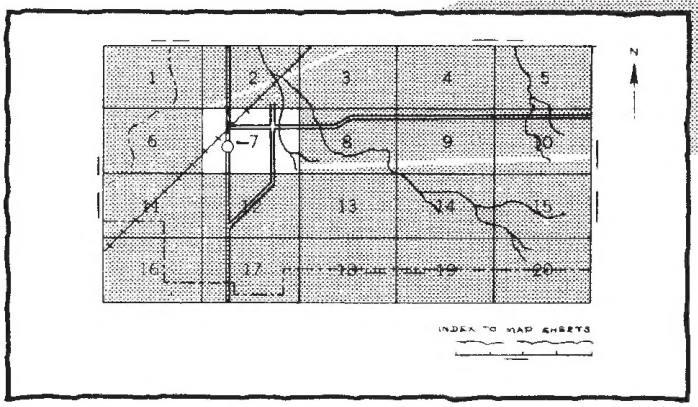
In Cooperation with
Oregon Agricultural
Experiment Station

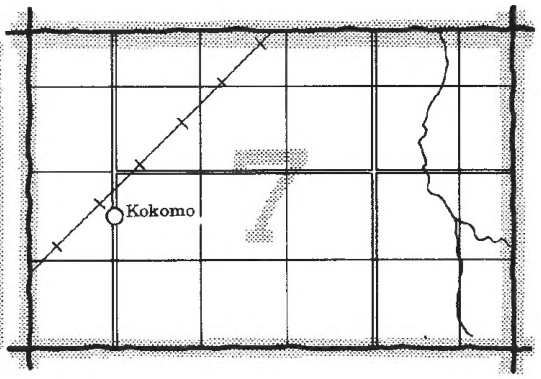
Soil Survey of Gilliam County Oregon



HOW TO USE

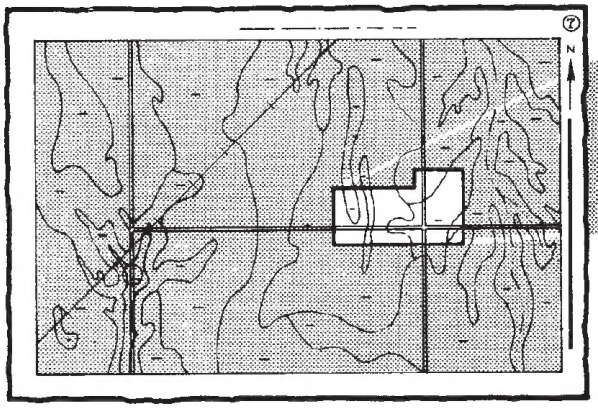
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

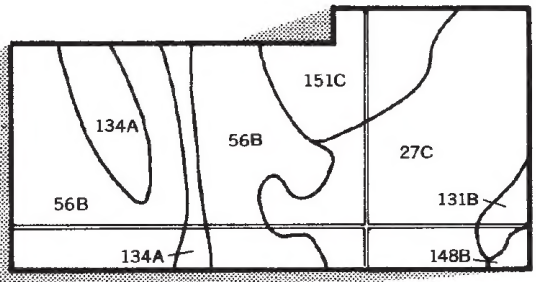




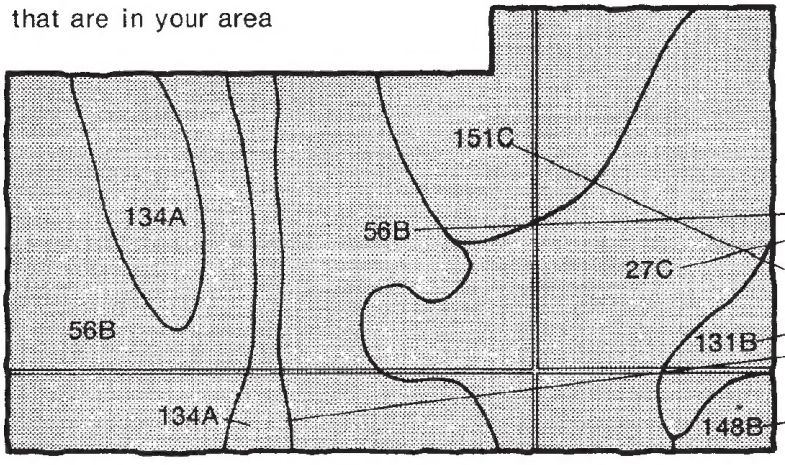
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area

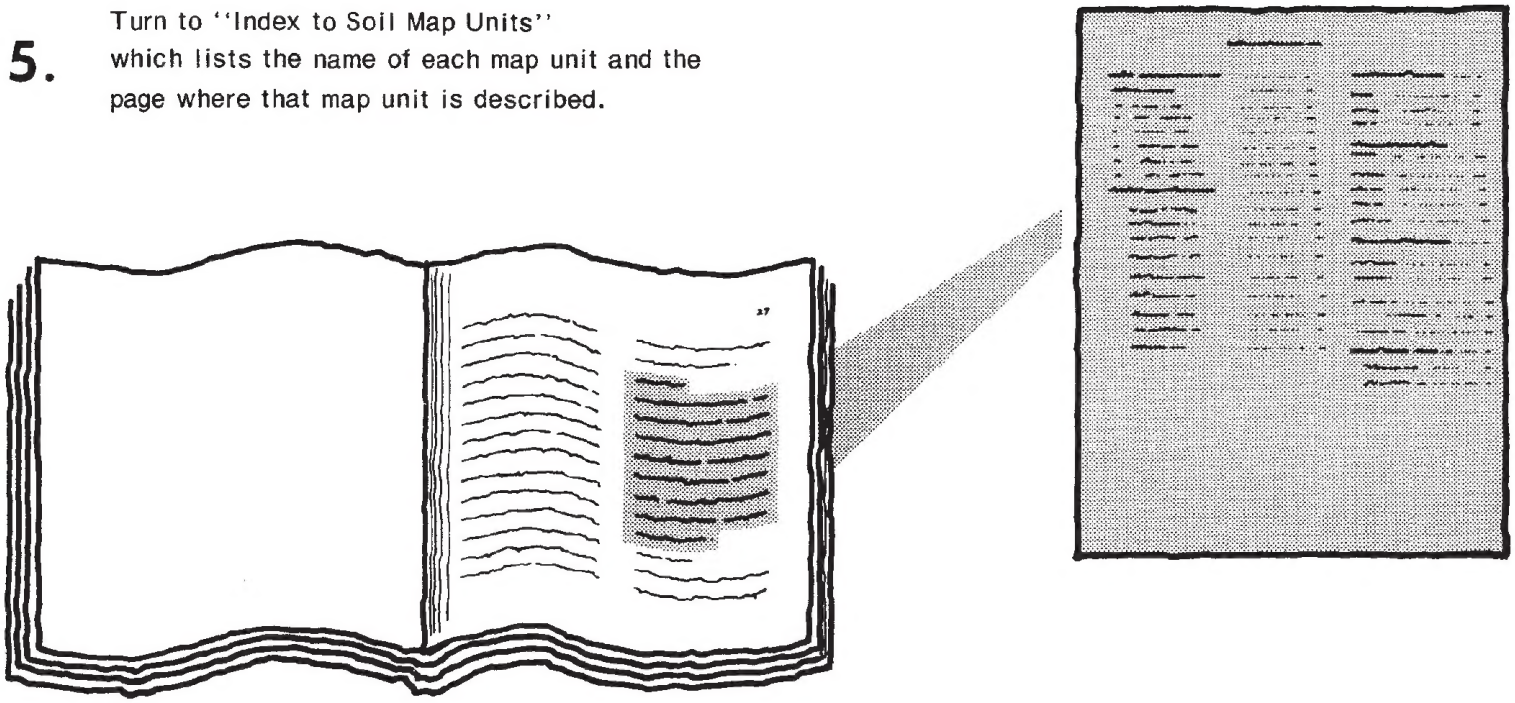


Symbols

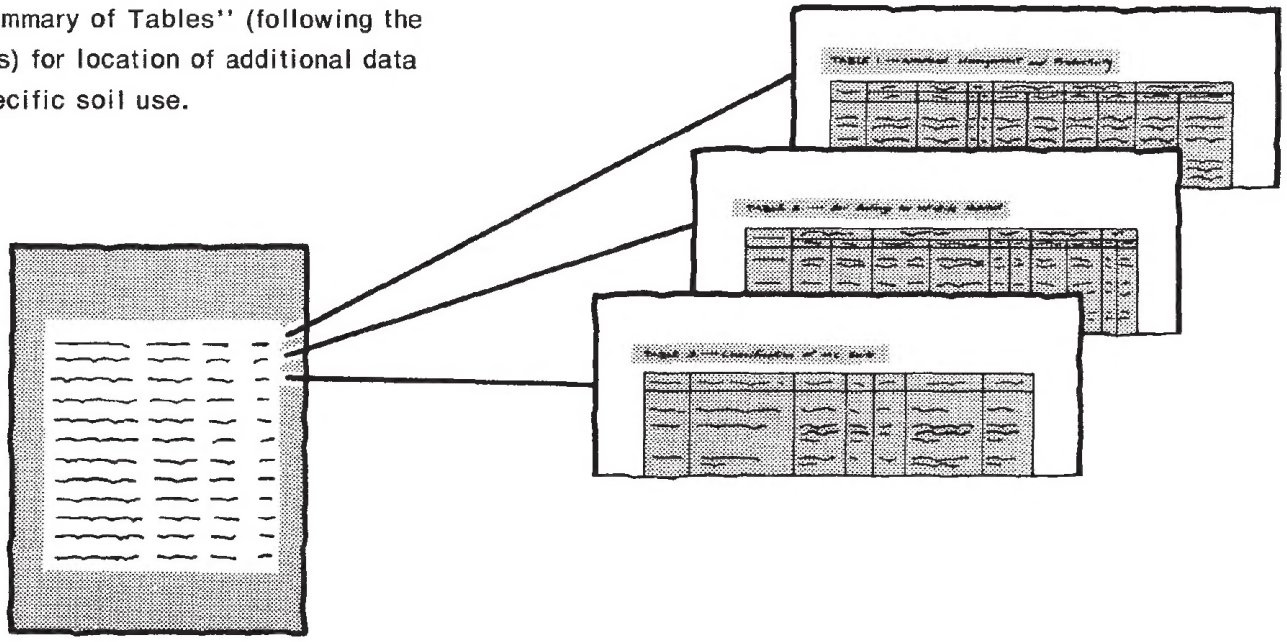
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1969-77. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the Oregon Agricultural Experiment Station. It is part of the technical assistance furnished to the Gilliam County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Irrigated alfalfa on Hermiston silt loam on bottom land along Rock Creek. Grain-fallow farming on Ritzville soils in background.

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Issued May 1984

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Foreword

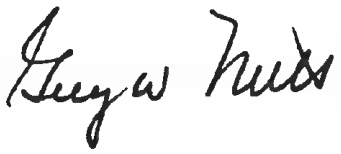
The Soil Survey of Gilliam County, Oregon, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

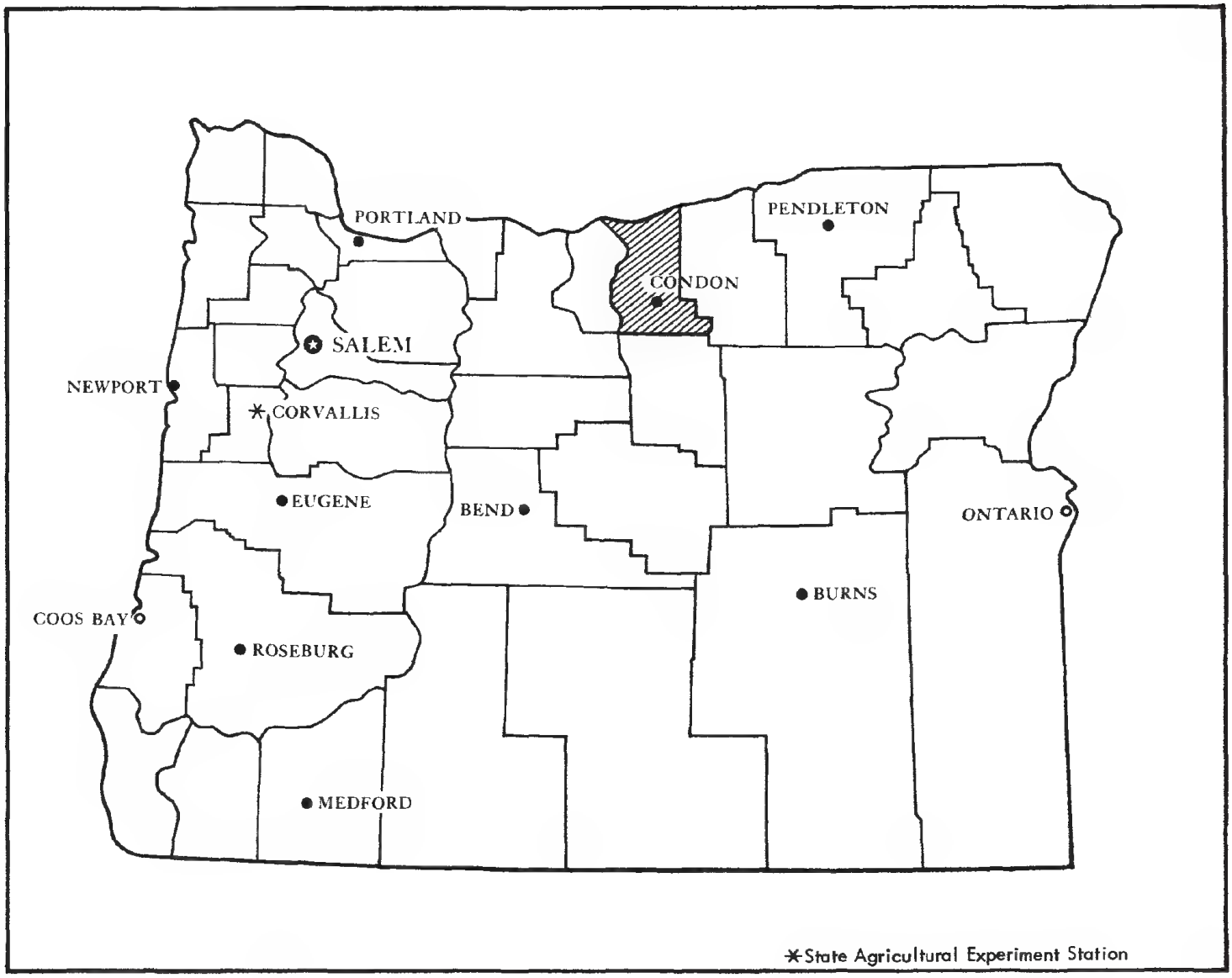
Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.



Guy W. Nutt
State Conservationist
Soil Conservation Service



Location of Gilliam County in Oregon.

SOIL SURVEY OF GILLIAM COUNTY, OREGON

By Richard E. Hosler, Soil Conservation Service

Fieldwork by Richard E. Hosler, David R. Johnson,
Duane K. Monte, George L. Green, Terry A. Dallin,
and Dal F. Ames, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with Oregon Agricultural Experiment Station

Gilliam County is in the north-central part of Oregon (see facing page). It has a total area of 779,520 acres, or 1,218 square miles (*8*). Condon, the county seat, has a population of 930.

General nature of the county

This section provides general information about the climate; physiography, relief, and drainage; farming and ranching; natural resources; and history and development of Gilliam County.

Climate

This section was prepared by the National Climatic Center, Asheville, North Carolina.

The Rocky Mountains partly shield Gilliam County from strong Arctic winds. Although the county is cold in winter, the winters are generally not severe. In summer, Pacific Ocean winds are partially blocked; days are hot but nights are fairly cool. Precipitation is scant in summer. In many places during the cooler part of the year, precipitation is adequate for nonirrigated small grain or range. The snowpack accumulation at high elevations supplies water for irrigation in parts of the lowland.

Tables 1 and 2 give temperature and precipitation for the survey area, as recorded at Arlington and Condon, Oregon, for the period 1951-73. Tables 3 and 4 show probable dates for the first freeze in fall and the last freeze in spring. Tables 5 and 6 provide data on length of the growing season.

In winter the average temperatures at Arlington and Condon are 37 and 33 degrees, respectively. The lowest temperature, -22 degrees, occurred at Arlington on January 27, 1957. In summer the average temperature is 73 degrees at Arlington and 64 degrees at Condon. The average daily maximum temperature is about 84. The highest recorded temperature, 115 degrees, occurred at Arlington on August 4, 1961.

Growing degree days, shown in tables 1 and 2, are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 9 inches at Arlington and about 14 inches at Condon. Of this, 30 percent usually falls in April through September, which includes the growing season for most crops. The heaviest 1-day rainfall during the period of record was 2.27 inches at Arlington on December 22, 1964. Thunderstorms occur on about 10 days each year, and most occur in summer.

Average seasonal snowfall is 9 inches at Arlington and 32 inches at Condon. The greatest snow depth at any one time during the period of record was 10 inches at Arlington and 17 inches at Condon. On the average, 3 days at Arlington and 10 days at Condon have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The percentage of possible sunshine is 70 in summer and 30 in winter. The prevailing wind is from the southwest. Average windspeed is highest, 10 miles per hour, in spring.

Physiography, relief, and drainage

Gilliam County is mainly within the Columbia Plateau physiographic province. An area in the southeastern part of the county is in the Blue Mountain section of this province. Generally, the rest of the county is a plain that was covered by molten basalt and then uplifted. The basalt in the floor of the plain is overlain by wind-deposit-

ed silt. Elevation of the plain ranges from about 250 feet along the Columbia River to about 3,600 feet near the border of the Blue Mountain section. Relief is dominantly nearly level to rolling on the stream dissected terrain.

The Blue Mountain section is a tilted, folded, and faulted uplift of the Columbia River basalt and older underlying rocks. This section is characterized by flattopped ridges, broad flats, and steep walled canyons. Topography is mainly the result of erosion and stream cutting in the basalt. Ash deposited during the past volcanic activity in the Cascade Mountains has influenced the soils in the Blue Mountain section, especially north-facing exposures (*4*). Elevation ranges from about 2,600 feet along some canyon bottoms to about 4,300 feet on the ridges.

The drainage pattern in the county is controlled mainly by the surface of the underlying basalt. The mantle of loess has had little effect on modifying this pattern. Stream gradient is determined by the tilt of the basalt.

About 584,400 acres of the county is drained to the west into the John Day River. The river forms the western boundary of Gilliam County. The major drainages in this watershed are Rock Creek, Thirtymile Creek, Hay Creek, Ferry Canyon, Lonerock Creek, and Lost Valley Creek. The rest of the county is drained to the north into the Columbia River, which forms the northern boundary of Gilliam County. The major drainages in this watershed are Quinton Creek, Blalock Canyon, Alkali Canyon, Eightmile Canyon, Fourmile Canyon, and Willow Creek.

Elevation of the main towns and communities in the county are Arlington, 285 feet; Olex, 1,000 feet; Mikkalo, 1,460 feet; Condon, 2,844 feet; Mayville, 2,946 feet; and Lonerock, 2,840 feet.

Farming and ranching

The first non-Indian settlers in Gilliam County were mainly ranchers who raised cattle, horses, and sheep. Farming became important when homesteaders began arriving in the 1870's and 80's. They settled in an area from Shutler Flat and Rock Creek in the north to Lonerock and Mayville in the south. They broke out the native bunchgrasses and grew mainly wheat in a crop-fallow rotation. In 1881, the first wheat crop in the county was raised and threshed on Shutler Flat. Because of poor transportation and the long distance to market, most crops were consumed locally until an adequate road system was constructed. In 1905 a railroad line was built from Arlington to Condon. This opened up outside markets for the farmers' crops (Unpublished "History of Gilliam County" by Mariam C. Thouvenel and Lovena S. Palmer, 1952).

The advent of gasoline and diesel powered tillage and harvesting machinery has resulted in large increases in the size of operating units.

Winter wheat and spring barley are grown almost exclusively in the dryland areas. At present, about 90 percent of the irrigated land is adjacent to the major streams. Alfalfa hay and wheat are generally grown in these areas. Where irrigation water is available, many soils in Gilliam County have high potential for such irrigated crops as potatoes, corn, wheat, and alfalfa hay.

In past years the raising of cattle and sheep was very important in Gilliam County, but in recent years its importance has declined. The sheep raised in the county now are mainly in the northern part. Many farmers maintain a herd of beef cattle in addition to their main grain operation.

Since the "Dust Bowl" years of the 1930's, interest in soil conservation has increased. In 1946, the Gilliam County Soil and Water Conservation District was organized.

Natural resources

The major natural resources in Gilliam County are the soil; the Columbia River and other perennial streams; underground water; wildlife; and recreation areas.

The soil is the most important natural resource in Gilliam County. About 90 to 95 percent of the inhabitants of the county are directly or indirectly associated with the soil. The major source of income is from crops or from livestock.

The Columbia River is an important resource to the entire county. It provides an avenue for barge transportation of crops to larger ports. It also provides hydroelectric power from the John Day Dam and other dams. At the present time, however, the Columbia River provides little water for irrigation in Gilliam County. The soils suitable for irrigation are at elevations and distances that make pumping of water from the river uneconomical.

Underground water supplies are tapped by deep wells throughout the county. These provide water for domestic use and for some irrigation. Most irrigation water is taken from perennial streams and is used to irrigate the adjacent bottom lands. Major perennial streams are the John Day River, Rock Creek, Thirtymile Creek, Willow Creek, and Lonerock Creek. Ninety percent of the irrigated land in the county is adjacent to these streams.

Gilliam County has a variety of wildlife. The wildlife is an important natural resource, especially game species. In rangeland and dryfarmed areas, mule deer, chukar, and Hungarian partridge are important game species. In the irrigated areas along streams, ring-necked pheasant and mule deer are common. Besides these game species, many other animals and birds, such as rabbits, coyotes, badgers, hawks, owls, and golden eagles, inhabit the area. Along the Columbia River, large flocks of geese and ducks congregate at certain times of the year. The Columbia River and some of the major streams in the county provide suitable habitat for such fish as salmon, steelhead, and sturgeon.

Recreational pursuits in Gilliam County include sightseeing, photography, visiting historical sites, boating and

swimming on the Columbia and John Day Rivers, and arrowhead hunting.

History and development

The Lewis and Clark expedition of 1805-06 passed the northern end of what is now Gilliam County. The expedition traveled by boat on the Columbia River but did not land and explore the area. Wagon trains traveled the Oregon Trail in the 1840's and 50's. The Trail crossed the northern end of the county about 5 to 10 miles south of the Columbia River. These travelers did not settle in Gilliam County, however.

The first permanent settlers arrived in the early 1860's and settled along the lower part of Rock Creek. They were mostly stockmen who grazed their cattle and horses on the bunchgrass rangeland. The first sheep came into the area in 1875 near Lonerock in the extreme southern part of the county.

Most early settlers came from the Willamette Valley in the 1870's and 80's. They traveled by wagon to Portland and then by ferry to The Dalles. From The Dalles they continued by wagon over the Oregon Trail to Gilliam County. Most of these people settled along Rock Creek, although many settled in the towns that are now known as Lonerock, Mayville, and Condon. Many homesteaders were farmers and grew wheat on the rolling hills from Shutler Flat in the north to Mayville in the south.

Gilliam County was organized in 1885. It was originally part of Wasco County. For the first 5 years, Alkali, now known as Arlington, was the county seat. In 1890 the county seat was moved to Condon. The population of the county was 3,600 in 1890 and increased to 3,960 in 1920. In 1976, the population was 2,200.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils

having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Areas dominated by moderately deep to very deep, well drained and excessively drained soils formed in eolian sands, alluvium, and lacustrine material in a 7 to 11 inch precipitation zone

These soils are on terraces near the Columbia River. Slope is 0 to 40 percent. These soils are well drained in most areas, but in some areas they are somewhat excessively drained. The hazard of soil blowing is moderate or severe.

These soils are in four map units. Most areas of these soils are used for range. Because of the low precipitation, crops are not suited unless irrigated. About 30 percent of the acreage of these soils is suited to irrigation, and if irrigated is suited to a wide variety of crops.

1. Quincy-Sagehill

Very deep, well drained and excessively drained fine sandy loams and loamy fine sands

This map unit consists of soils that formed in mixed sands, loess, and calcareous lacustrine sediment. These soils are on terraces. Slope is 0 to 40 percent. The native vegetation is needleandthread, Indian ricegrass, bluebunch wheatgrass, Sandberg bluegrass, and associated shrubs and forbs. Elevation is 500 to 1,200 feet. The average annual precipitation is 7 to 9 inches, and the average annual temperature is 49 to 54 degrees F. The frost-free period is 140 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

This map unit makes up 1 percent of the county. It is about 45 percent Quincy soils and 40 percent Sagehill soils. Rock outcrop and Dune land make up about 10 percent of this map unit. Roloff and Nansene soils make up about 5 percent.

The Quincy soils to a depth of 60 inches or more are very dark grayish brown loamy fine sand.

The Sagehill soils have a surface layer of dark brown fine sandy loam. The subsoil is dark brown fine sandy loam and very fine sandy loam. The substratum to a depth of 60 inches or more is dark grayish brown and grayish brown silt loam.

The soils in this map unit are used for irrigated potatoes, alfalfa hay, and winter wheat. They are also used for range and wildlife habitat.

Areas of this map unit provide habitat for a small number of mule deer. Birds and small animals are common. Such upland game birds as ring-necked pheasant are in areas of irrigated crops. Areas of this unit near the Columbia River, especially areas of cropland, are used by waterfowl. Areas that border the Columbia River have potential for fishing for steelhead and salmon.

In areas of this map unit, runoff is slight to moderate and sedimentation as a result of runoff is low to moderate. The hazard of soil blowing is high. Maintaining maximum plant cover on rangeland and irrigated fields and using proper irrigation methods on cropland help reduce erosion.

2. Roloff

Moderately deep, well drained silt loams

This map unit consists of soils that formed in loess and alluvial sand over basalt. These soils are on terraces. Slope is 0 to 20 percent. The native vegetation is needleandthread, Indian ricegrass, bluebunch wheatgrass, and associated shrubs and forbs. Elevation is 250 to 900 feet. The average annual precipitation is 7 to 10 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 140 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

This map unit makes up 2 percent of the county. It is about 80 percent Roloff soils. Blalock, Olex, Quincy, and Sagehill soils and Rock outcrop make up about 20 percent of this map unit.

The Roloff soils have a surface layer of very dark grayish brown silt loam. The subsoil and substratum are dark brown silt loam. Basalt is at a depth of 20 to 40 inches.

The soils in this map unit are used mainly for range. A few areas are used for irrigated pasture, and some areas are used for wildlife habitat.

Areas of this map unit provide habitat for a small number of mule deer. Birds and small animals are common. Such upland game birds as ring-necked pheasant are in areas of irrigated crops. Areas of this unit near the Columbia River, especially areas of cropland, are used by waterfowl. Areas that border the Columbia River have potential for fishing for steelhead and salmon.

In areas of this map unit, runoff is slight and sedimentation as a result of runoff is low. Maintaining maximum plant cover on rangeland and irrigated pasture and using proper irrigation methods on cropland help reduce erosion.

3. Olex-Krebs

Deep, well drained silt loams and gravelly silt loams

This map unit consists of soils formed in loess and very gravelly alluvial deposits. Slope is 0 to 40 percent. The native vegetation is bluebunch wheatgrass, Sandberg bluegrass, and a variety of perennial forbs. Eleva-

tion is 500 to 1,200 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

This map unit makes up 5 percent of the county. It is about 70 percent Olex soils and 20 percent Krebs soils. Blalock, Roloff, Sagehill, and Willis soils make up about 10 percent of this map unit.

The Olex soils are on terraces. The surface layer is dark brown or very dark grayish brown silt loam. The subsoil is dark brown or brown gravelly silt loam. The upper part of the substratum is dark brown or brown very gravelly silt loam, and the lower part of the substratum to a depth of 60 inches or more is brown, calcareous extremely gravelly silt loam.

The Krebs soils are on uplands. The surface layer is very dark grayish brown silt loam and silty clay loam. The subsoil is dark brown, brown, and pale brown silty clay loam and silty clay. The substratum is pale brown silty clay loam. Diatomite is at a depth of 40 to 60 inches.

The soils in this map unit are used mainly for range. They are also used for wildlife habitat.

Areas of this map unit provide habitat for a small number of mule deer. Birds and small animals are common.

Runoff in areas of this map unit is mainly from the steeper slopes. Sedimentation as a result of runoff is moderate or high. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

4. Warden-Sagehill

Very deep, well drained fine sandy loams and silt loams

This map unit consists of soils that formed in loess and calcareous lacustrine sediment. Slope is 2 to 40 percent. The native vegetation is bluebunch wheatgrass, Sandberg bluegrass, needleandthread, and associated shrubs and forbs. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

This unit makes up 5 percent of the county. It is about 55 percent Warden soils and 40 percent Sagehill soils. Blalock, Olex, and Willis soils make up about 5 percent of this map unit.

The Warden soils are on uplands. The surface layer is dark brown silt loam. The subsoil is dark brown and brown silt loam. The upper part of the substratum is brown silt loam, and the lower part of the substratum is calcareous, grayish brown and dark grayish brown silt loam. Basalt is at a depth of 60 inches or more.

The Sagehill soils are on terraces. The surface layer is dark brown fine sandy loam. The subsoil is dark brown fine sandy loam and very fine sandy loam. The substratum is dark grayish brown and grayish brown silt loam.

The soils in this map unit are used mainly for small grain in a crop-fallow rotation. Wheat and barley are the main crops. These soils are also used for range and wildlife habitat. Where water is available for irrigation, these soils have potential for irrigated wheat, potatoes, corn, and alfalfa hay.

Areas of this map unit provide habitat for a small number of mule deer. Birds and small animals are common. In the steeper areas and along drainageways this map unit provides suitable habitat for chukar.

In areas of this map unit, runoff is mainly from the steeper dryfarmed soils on side slopes. Sedimentation, as a result of runoff, is moderate or high. The hazard of soil blowing is high on the Sagehill soils. The use of stubble mulch tillage, minimum tillage, and diversions helps reduce erosion. Maintaining maximum plant cover on rangeland and seeding and cultivating at the proper time also help reduce erosion.

Areas dominated by very deep, well drained and somewhat excessively drained soils formed in recent alluvium in an 8 to 14 inch precipitation zone

These soils are on bottom lands along Rock and Willow Creeks and in Eightmile Canyon. Slope is mainly 0 to 3 percent. These soils are somewhat excessively drained in about half of the areas and are well drained in the rest. The hazard of streambank erosion is severe, and in about half of the acreage the hazard of soil blowing is moderate.

These soils are in one map unit. About half of the acreage of these soils is used for irrigated hay and pasture.

5. Xeric Torrifluvents-Kimberly

Very deep, well drained and somewhat excessively drained fine sandy loams

This map unit consists of soils that formed in recent mixed alluvium. Slope is 0 to 3 percent. The native vegetation is giant wildrye, shrubs, and forbs. Elevation is 300 to 1,200 feet. The average annual precipitation is 8 to 12 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

This map unit makes up about 2 percent of the county. It is about 40 percent Xeric Torrifluvents and 30 percent Kimberly soils. Hermiston, Powder, and Stanfield soils and Riverwash make up about 30 percent of this map unit.

The Xeric Torrifluvents are somewhat excessively drained. The surface layer is dark brown fine sandy loam. The upper part of the substratum is brown fine sandy loam and loamy fine sand, and the lower part of the substratum is dark brown loamy fine sand and grav-

elly loamy sand. Bedrock is at a depth of more than 60 inches.

The Kimberly soils are well drained. The surface layer is dark brown fine sandy loam. The substratum is moderately calcareous, dark brown and very dark grayish brown fine sandy loam and sandy loam. Bedrock is at a depth of more than 60 inches.

The soils in this map unit are used for irrigated alfalfa hay and winter wheat and for range.

Areas of this map unit provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. Chukar use areas of these soils and adjacent slopes for food and cover. Areas provide food and limited cover for mule deer and smaller animals. Willow creek, which flows through this unit, is suitable trout habitat and has potential for fishing.

Areas of this map unit are susceptible to rare flooding. Streambanks need to be properly sloped and stabilized to minimize bank cutting and sediment pollution of streams at times of heavy runoff.

Areas dominated by very shallow to very deep, well drained soils formed in loess and colluvium in a 9 to 14 inch precipitation zone

These soils are on ridges and side slopes throughout the county, except in the northeastern and southeastern parts. Slope is 0 to 70 percent. The hazard of water erosion is moderate to severe in many areas.

These soils are in five map units. About half of the areas are farmed, and most of these are in a grain-fallow rotation. The rest are used mainly for range.

6. Walla Walla

Very deep, well drained silt loams

This map unit consists of soils formed in loess and small amounts of volcanic ash. These soils are on ridgetops and side slopes. Slope is 1 to 35 percent. The native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. Elevation is 900 to 1,200 feet. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 49 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

This map unit makes up 2 percent of the county. It is about 75 percent Walla Walla soils. Lickskillet soils make up about 10 percent of this map unit and Nansene, Roloff, and Wrentham soils make up about 15 percent.

The Walla Walla soils have a surface layer of very dark grayish brown silt loam. The subsoil is brown and dark brown silt loam, and the substratum is calcareous, brown silt loam. Bedrock is at a depth of more than 60 inches.

The soils in this map unit are used mainly for winter wheat in a grain-fallow rotation. Soils that are too steep for cultivation are used for range. Where water is available, these soils have high potential for irrigated crops.

Areas of this map unit provide food and cover for mule deer and small animals. In the steeper breaks along the Columbia River and along drainageways, habitat is suitable for chukar. Where this map unit borders the Columbia River, it is used by a large variety of waterfowl. The fishing potential for steelhead and salmon is good.

Runoff is a concern to management in all but the more level areas of this map unit. Sedimentation from runoff is moderate or high. Using stubble mulch tillage, minimum tillage, and other proper practices on cropland helps reduce erosion. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

7. Ritzville-Mikkalo

Moderately deep and very deep, well drained silt loams

This map unit consists of soils that formed in loess. These soils are on ridgetops and side slopes. Slope is 0 to 40 percent. The native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. Elevation is 900 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

This map unit makes up about 25 percent of the county. It is about 65 percent Ritzville soils and 20 percent Mikkalo soils. Bakeoven, Lickskillet, and Willis soils and Rock outcrop make up about 15 percent of this map unit.

The Ritzville soils have a surface layer and subsoil of dark brown silt loam. The substratum is calcareous, brown silt loam. Bedrock is at a depth of more than 60 inches.

The Mikkalo soils are on ridgetops and south-facing exposures. The surface layer is very dark grayish brown and dark brown silt loam. The subsoil is dark brown silt loam, and the substratum is calcareous, brown silt loam. Basalt is at a depth of 20 to 40 inches.

The soils in this map unit are used mainly for wheat and barley in a grain summer-fallow rotation. Soils that are too steep for cultivation are used for range. The soils in a few areas are irrigated and used for wheat and alfalfa hay.

Areas of this map unit provide food and cover for mule deer and small animals. The major bottom lands provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. The areas on steeper breaks and along drainageways provide suitable habitat for chukar.

Runoff is a concern to management in all but the more level areas of this map unit. Sedimentation from runoff is moderate or high. Using stubble mulch tillage, minimum

tillage, and diversions on cropland helps reduce erosion. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

8. Lickskillet-Wrentham

Shallow and moderately deep, well drained very gravelly silt loams and very stony loams

This map unit consists of soils that formed in loess mixed with colluvium from basalt (fig. 1). Slope is 7 to 70 percent. The native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. Elevation is 260 to 3,600 feet. The average annual precipitation is 10 to 14 inches, and the average annual temperature is 45 to 52 degrees F. The frost-free period is 60 to 150 days at 32 degrees and 100 to 210 days at 28 degrees.

This map unit makes up 26 percent of the county. It is about 50 percent Lickskillet soils and 15 percent Wrentham soils. Bakeoven, Condon, Valby, Nansene, Mikkalo, Morrow, and Rhea soils make up about 35 percent of this map unit.

The Lickskillet soils are on generally south-facing exposures. The surface layer is dark brown very stony loam. The subsoil is dark brown very gravelly loam and clay loam. Basalt is at a depth of 12 to 20 inches.

The Wrentham soils are on steep, north-facing exposures. The surface layer is very dark brown silt loam. The subsoil is gravelly and very gravelly silt loam. Basalt is at a depth of 20 to 40 inches.

The soils in this map unit are used for range and wildlife habitat.

The steep areas in this map unit and the adjacent bottom lands provide good habitat for chukar and other upland game birds, such as ring-necked pheasant and valley quail. Mule deer use areas of the Wrentham soil in summer and fall because of the cooler temperatures and proximity to cover. They use areas of the Lickskillet soil during spring and winter because of the warmer temperatures and proximity to cover. A variety of small animals are common. Rock Creek and Thirtymile Creek, which flow through this map unit, are suitable trout habitat and provide potential for fishing. The John Day and Columbia Rivers, which border this map unit, provide habitat for steelhead, salmon, and other fish.

The hazard of water erosion is high in this map unit. Sedimentation from runoff is low or moderate. Maintain-

Figure 1.—Area of the Lickskillet-Wrentham unit on the general soil map. In left middle is Wrentham-Rock outcrop complex, 35 to 70 percent slopes. In right middle and background is Lickskillet-Rock outcrop complex, 40 to 70 percent slopes.

ing maximum plant cover on rangeland minimizes the hazard of erosion.

9. Condon-Valby

Moderately deep, well drained silt loams

This map unit conists of soils that formed in loess. These soils are on uplands. Slope is 1 to 35 percent. The native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

This map unit makes up 14 percent of the county. It is about 60 percent Condon and Valby soils. Bakeoven, Lickskillet, Rhea, and Wrentham soils and Rock outcrop make up about 40 percent of this unit.

The Condon soils have a surface layer of very dark brown silt loam. The subsoil is very dark grayish brown and dark brown silt loam, and the substratum is dark brown silt loam. Basalt is at a depth of 20 to 40 inches.

The Valby soils have a surface layer of very dark brown silt loam. The subsoil is very dark grayish brown and dark brown silt loam, and the substratum is calcareous, brown silt loam. Basalt is at a depth of 20 to 40 inches.

The soils in this map unit are used mainly for wheat and barley in a crop-fallow rotation. The soils that are too steep to be cultivated are used for range or wildlife habitat.

Areas of this map unit provide food and cover for mule deer and small animals. The areas on steeper breaks and along drainageways provide suitable habitat for chukar. Rock Creek provides suitable habitat for trout and has potential for fishing.

Runoff in areas of this map unit is mainly from the steeper dryfarmed side slopes. Sedimentation as a result of runoff is moderate or high. Using stubble mulch tillage and diversions in cropland helps reduce erosion. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

10. Morrow-Bakeoven

Very shallow and moderately deep, well drained silt loams and very cobbly loams

This map unit consists of soils that formed in loess and in colluvium from basalt. These soils are on ridgetops. Slope is 1 to 70 percent. The native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. Elevation is 1,000 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 52 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 140 to 180 days at 28 degrees.

This map unit makes up 12 percent of the county. It is about 60 percent Morrow soils and 20 percent Bakeoven soils. Lickskillet and Wrentham soils and Rock outcrop make up about 20 percent of this map unit.

The Morrow soils have a surface layer of very dark brown silt loam. The subsoil is dark grayish brown and brown silty clay loam, and the substratum is brown silt loam. Basalt is at a depth of 20 to 40 inches.

The Bakeoven soils have a surface layer of dark brown very cobbly loam. The subsoil is dark brown very cobbly loam and very cobbly clay loam. Basalt is at a depth of 4 to 12 inches.

The soils in this map unit are mainly used for range and wildlife habitat. They are also used for wheat and barley in a crop-fallow rotation.

Areas of this map unit provide food and cover for mule deer and small animals. The main bottom lands provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. The areas on steeper breaks and along drainageways provide suitable habitat for chukar. Rock Creek and Thirtymile Creek, which dissect this unit, are suitable habitat for trout and have potential for fishing.

Runoff in areas of this map unit is mainly from the steeper dryfarmed slopes of the Morrow soils. Sedimentation as a result of runoff is moderate. Using stubble mulch tillage and diversions in cropland helps reduce erosion. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

Areas dominated by very shallow to very deep, well drained soils formed in loess, colluvium and residuum from basalt, and lacustrine sediment in a 14 to 18 inch precipitation zone

These soils are on ridgetops and side slopes on uplands in the southeastern part of the county. Slope is 1 to 70 percent. The hazard of water erosion is moderate to severe in many areas.

These soils are in two map units. Most areas of these soils are in rangeland. About 10 percent of the acreage is farmed, and most of this is in a grain-fallow rotation.

11. Waha-Gwinly-Rockly

Very shallow to moderately deep, well drained silt loams, very cobbly loams, and very cobbly silt loams

This map unit consists of soils that formed in loess and in colluvium and residuum from basalt. Slope is 1 to 70 percent. The native vegetation is Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, shrubs, and forbs. Elevation is 3,000 to 4,300 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free

period is 90 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

This map unit makes up 5 percent of the county. It is about 45 percent Waha soils, 20 percent Gwinly soils, and 15 percent Rockly soils. Kahler, Tub, and Ukiah soils and Rock outcrop make up about 20 percent of this map unit.

Waha soils are on ridgetops, and where sloping are mainly on north-facing exposures. The surface layer is very dark brown silt loam. The subsoil is dark brown and brown silty clay loam and extremely cobbly silt loam. Basalt is at a depth of 20 to 40 inches.

The Gwinly soils are on south-facing exposures. The surface layer is very dark grayish brown very cobbly silt loam. The subsoil is very dark grayish brown and dark yellowish brown very cobbly silty clay loam and extremely cobbly clay. Basalt is at a depth of 12 to 20 inches.

The Rockly soils are on ridgetops. The surface layer is dark brown very cobbly loam. The subsoil is dark brown extremely cobbly clay loam. Basalt is at a depth of 5 to 12 inches.

The soils in this map unit are used for wheat and barley in a crop-fallow rotation. They are also used for range and wildlife habitat.

Areas of this map unit provide food and cover for mule deer and small animals.

Runoff is mainly from the steeper dryfarmed areas of Waha soils and the steeper areas of Gwinly soils. Using stubble mulch tillage and diversions in cropland helps reduce erosion. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

12. Tub-Simas-Ukiah

Moderately deep and very deep, well drained stony silt loams, cobbly silty clay loams, and stony silty clay loams

This map unit consists of soils that formed in loess and in colluvium and residuum from old lacustrine sediment and volcanic tuff. Slope is 1 to 40 percent. The native vegetation is Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, shrubs, and forbs. Elevation is 3,000 to 3,900 feet. The average annual precipitaion is 14 to 18 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free period is 90 to 130 days at 32 degrees and 100 to 150 days at 28 degrees.

This map unit makes up 1 percent of the county. It is about 55 percent Tub soils, 25 percent Simas soils, and 15 percent Ukiah soils. Gwinly, Schrier, and Kahler soils make up about 5 percent of this map unit.

The Tub soils are on uplands, and where sloping are mainly on north-facing exposures (fig. 2). The surface layer is black stony silty clay loam. The subsoil is black and dark grayish brown cobbly clay and silty clay loam. The substratum to a depth of 60 inches or more is calcareous, dark brown silty clay loam.

The Simas soils are on south-facing exposures. The surface layer is dark grayish brown very stony silt loam and very cobbly silty clay loam. The subsoil is dark brown cobbly clay. The substratum to a depth of 60 inches or more is calcareous, yellowish brown very cobbly clay loam.

The Ukiah soils are on uplands, and where sloping are mainly on south-facing exposures. The surface layer is very dark brown cobbly silty clay loam. The subsoil is dark brown cobbly clay. The substratum is dark brown and strong brown silty clay loam and gravelly loam. Volcanic tuff is at a depth of 20 to 40 inches.

The soils in this map unit are used for wheat and barley for grain and hay in a crop-fallow rotation. These soils are also used for range and wildlife habitat.

Areas of this map unit provide food and cover for mule deer, small animals, and upland game birds.

Runoff is mainly from the steeper dryfarmed areas of Tub and Ukiah soils but is also from steeper areas of all soils in this map unit. Using stubble mulch tillage in cropland and maintaining maximum plant cover on rangeland minimize the hazard of erosion.

Broad land use considerations

Most areas of soils in the Quincy-Sagehill map unit west of Willow Creek are developed for irrigation. If irrigated, vegetables, small grain, hay, and many specialty crops are well suited to soils in this map unit. Before irrigation was provided, the areas were only suitable for limited grazing by livestock in winter.

Soils in the Roloff, Warden-Sagehill, Walla Walla, and Ritzville-Mikkalo map units are currently used for dryfarmed small grain. Large areas of these units, however, are well suited to irrigation. Development of irrigation in extensive areas of these map units depends on the feasibility of providing adequate irrigation water. If soils in these units are irrigated, potential is good for a large variety of crops. A few areas of deep soils in the Ritzville-Mikkalo map unit are irrigated from deep wells.

Some areas of soils in the Walla Walla, Warden-Sagehill, and Ritzville-Mikkalo map units and most areas in the Roloff map unit are underlain by bedrock or hardpan at a depth of less than 40 inches. If these soils or the adjacent, higher lying soils are overirrigated, a high water table readily develops. The pattern of these soils needs to be considered to properly locate irrigation systems.

Soils in the Quincy-Sagehill, Warden-Sagehill, Walla Walla, and Ritzville-Mikkalo map units are generally well suited to community uses. An important consideration, however, in the Quincy-Sagehill and Warden-Sagehill map units is susceptibility of the sandy soils to soil blowing. Areas of soils in the Walla Walla and Ritzville-Mikkalo map units that are moderately deep over bedrock or hardpan and most areas of the Roloff map unit require design modifications for sanitary facilities and various other uses.

Areas of soils in the Olex-Krebs map unit are used mainly for range and wildlife habitat. Many soils in this map unit are not well suited to irrigation or community uses because of the gravelly and very gravelly subsoil.

Figure 2.—Tub stony silty clay loam, 12 to 40 percent slopes, in center of picture. Tub gravelly clay loam, 2 to 12 percent slopes, in summer fallow on the right.

Arable soils in the Condon-Valby, Morrow-Bakeoven, and Waha-Gwinly-Rockly map units are currently used in a grain-fallow rotation. In the absence of water for irrigation, grain-fallow cropping will probably continue to be used on soils in these map units.

Soils in the Lickskillet-Wrentham map unit are steep and rocky. These soils are used for rangeland and wildlife habitat and are poorly suited to other uses.

Areas of soils in the Xeric Torrifluvents-Kimberly map unit are mainly on flood plains along Willow and Rock Creeks and in Eightmile Canyon. Although nearly all these soils are deep and well drained, they are subject to rare flooding and are not well suited to community uses and sanitary facilities. Almost all areas of Kimberly soils in this map unit are irrigated and used for alfalfa hay and pasture, even though they are well suited to a wide variety of crops. The Xeric Torrifluvents are used mostly for range, but if irrigated, these soils can be used for a wide variety of crops.

Soils in the Tub-Simas-Ukiah map unit, mostly in the Lonerock and Lost Valley areas, are mainly used for livestock grazing and alfalfa hay. A few areas are used for dryfarmed small grain and grain-hay crops. Most soils in this map unit are limited for community developments unless design modifications are made.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have similar profiles make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Ritzville silt loam, 2 to 7 percent slopes, is one of several phases within the Ritzville series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes and undifferentiated groups.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Bakeoven-Condon complex, 2 to 20 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the dominant (named) soils or may have all of them. Condon and Valby silt loams, 1 to 7 percent slopes, is an undifferentiated group in this survey area.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Dune land is an example.

The acreage and proportionate extent of each map unit are given in table 7, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

1D—Bakeoven very cobbly loam, 2 to 20 percent slopes. This very shallow, well drained soil is on ridgetops and plateaus. Average slope is 5 percent. Elevation is 1,000 to 3,600 feet. The average annual precipitation is 10 to 14 inches, and the average annual temperature is 48 to 52 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 140 to 180 days at 28 degrees.

Typically, the surface layer is dark brown very cobbly loam about 4 inches thick. The subsoil is dark brown very cobbly loam and very cobbly clay loam about 6 inches thick. It is underlain by basalt.

Included with this soil in mapping are 10 percent Lickskillet soils and 5 percent Morrow, Condon, and Valby soils.

Permeability of the Bakeoven soil is moderately slow. Effective rooting depth is 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is less than 2.5 inches (*3*). Runoff is slow to medium, and the hazard of erosion is moderate.

Areas of this soil are used for grazing by livestock and for wildlife habitat.

The main need in managing this soil is the maintenance of plant cover to help control water erosion.

The native plant community on this soil consists chiefly of very shallow rooted plants, mainly Sandberg bluegrass. Stiff sagebrush occurs in varying amounts but generally is prominent. Perennial forbs, such as serrated balsamroot, snow eriogonum, and phlox, commonly occur in minor amounts.

When range deteriorates on this soil, Sandberg bluegrass and stiff sagebrush decrease and low-value forbs increase. On severely deteriorated range, most plants are nearly eliminated and a rock pavement is formed. Because of stones and very shallow depth to rock, seedbed preparation and seeding of poor condition range are not practical on this soil.

Areas of this soil provide limited food and cover for mule deer, small animals, game birds, and songbirds.

This soil is severely limited for community and recreational uses because of stoniness and the shallow depth to bedrock. Extensive design modifications are necessary but in most cases are not practical for the development of dwellings, small buildings, and sanitary facilities.

This soil is in capability subclass VIIs.

2D—Bakeoven-Condon complex, 2 to 20 percent slopes. These soils are on ridgetops. Average slope is 5 percent. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 47 to 52 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 140 to 180 days at 28 degrees.

This complex is about 50 percent Bakeoven soil and about 30 percent Condon soil. These soils are in patterns that are locally known as "biscuit-scabland." The Bakeoven soil is scabland between and around the areas of Condon soil. If slope is less than 10 percent, the Condon soil is on circular mounds, or biscuits, that have a convex surface and are deeper in the center than on the edges. Where slope is more than 10 percent, the Condon soil is on elongated mounds in which the long axis is parallel to the slope. The circular mounds are 20 to 50 feet in diameter and 20 to 40 feet apart. The elongated mounds are 100 to 300 feet long and 30 to 60 feet wide.

Included with these soils in mapping are about 10 percent Valby and Rhea soils and 10 percent Lickskillet soils.

Typically, the surface layer of the Bakeoven soil is dark brown very cobbly loam about 4 inches thick. The subsoil is dark brown very cobbly loam and very cobbly clay loam about 6 inches thick. It is underlain by basalt.

Permeability of the Bakeoven soil is moderately slow. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is less than 2.5 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Typically the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Areas of this complex are used for grazing by livestock and for wildlife habitat.

The main need in managing these soils is the maintenance of plant cover to help control water erosion.

The native plant community on the Bakeoven soil is mainly Sandberg bluegrass and varying amounts of stiff sagebrush. A few low-growing perennial forbs commonly occur in minor amounts. The native plant community on the Condon soil is mainly bluebunch wheatgrass. Idaho fescue, Sandberg bluegrass, and a variety of perennial forbs are prominent. Shrubs are minor in the stand.

When range deteriorates on this complex, bluebunch wheatgrass decreases and Sandberg bluegrass and low-value forbs increase. If deterioration is severe, bunchgrass on the Condon soil and stiff sagebrush on the Bakeoven soil are nearly eliminated. On severely deteriorated range, annual weeds and few shrubs occupy the deeper Condon soil, and a rock pavement is formed on the interspersed Bakeoven soil. Because of stoniness and very shallow depth of the Bakeoven soil, seedbed preparation and seeding of poor condition range generally are not practical on this complex.

Most areas of this complex provide food and limited cover for mule deer, small animals, game birds, and songbirds.

The Bakeoven soil is severely limited for community and recreational uses because of depth to bedrock and stoniness. Extensive design modifications are necessary but in most cases are not practicable for the development of dwellings, small buildings, and sanitary facilities. The Condon soil is limited for community uses because of depth to bedrock, small size of soil areas, and slope. Design modifications are needed for the development of dwellings, small buildings, and sanitary facilities.

This complex is in capability subclass VIIs.

3D—Bakeoven-Morrow complex, 2 to 20 percent slopes. These soils are on ridgetops. Average slope is 5 percent. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 47 to 52 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 140 to 180 days at 28 degrees.

This complex is about 50 percent Bakeoven soil and 35 percent Morrow soil. These soils are in patterns that are locally known as "biscuit-scabland." The Bakeoven soil is scabland between and around areas of Morrow soil. If slope is less than 10 percent, the Morrow soil is on circular mounds, or biscuits, that have a convex surface and are deeper in the center than on the edges. If slope is more than 10 percent, the Morrow soil is on elongated mounds in which the long axis is parallel to the slope. The circular mounds are 20 to 50 feet in diameter and 20 to 40 feet apart. The elongated mounds are 100 to 300 feet long and 30 to 60 feet wide.

Included with these soils in mapping are 15 percent Lickskillet soils.

Typically, the surface layer of the Bakeoven soil is dark brown very cobbly loam about 4 inches thick. The subsoil is dark brown very cobbly loam and very cobbly clay loam about 6 inches thick. It is underlain by basalt.

Permeability of the Bakeoven soil is moderately slow. Effective rooting depth is 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is less than 2.5 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Typically, the surface layer of the Morrow soil is very dark brown silt loam about 9 inches thick. The upper part of the subsoil is very dark grayish brown silty clay loam about 4 inches thick, and the lower part of the subsoil is brown light silty clay loam about 7 inches thick. The

substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacty is 5 to 9 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Areas of this complex are used for grazing by livestock and for wildlife habitat.

The main need in managing these soils is the maintenance of plant cover to help control water erosion.

The native plant community on the Bakeoven soil is mainly Sandberg bluegrass and varying amounts of stiff sagebrush. A few low-growing perennial forbs commonly occur in minor amounts. The native plant community on the Morrow soil is mainly bluebunch wheatgrass. Idaho fescue, Sandberg bluegrass, and a variety of perennial forbs are prominent. Shrubs are minor in the stand.

When range deteriorates on this complex, bluebunch wheatgrass decreases and Sandberg bluegrass and low-value forbs increase. If deterioration is severe, bunchgrass on the Morrow soil and stiff sagebrush on the Bakeoven soil are nearly eliminated. On severely deteriorated range, annual weeds and a few shrubs occupy the deeper Morrow soil, and a rock pavement is formed on the interspersed Bakeoven soil. Because of stoniness and very shallow depth of the Bakeoven soil, seedbed preparation and seeding of poor condition range generally are not practical on this complex.

Most areas of this complex provide food and limited cover for mule deer, small animals, game birds, and songbirds.

The Bakeoven soil is severely limited for community and recreational uses because of depth to bedrock and stoniness. Extensive design modifications are necessary but in most cases are not practicable for the development of dwellings, small buildings,and sanitary facilities. The Morrow soil is limited for community uses because of depth to bedrock, moderately slow permeability, small size of soil areas, and slope. Design modifications are needed for the development of dwellings, small buildings, and sanitary facilities.

This complex is in capability subclass VIIs.

4C—Blalock loam, 2 to 12 percent slopes. This shallow, well drained soil is on uplands. It formed in loess. Average slope is 7 percent. Elevation is 500 to 900 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 52 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown loam about 7 inches thick. The subsoil is brown loam and gravelly loam about 11 inches thick over a light brownish gray, very gravelly, indurated hardpan about 4 inches thick. The substratum is calcareous, brown gravelly loam about 19 inches thick. It is underlain by partially decomposed shale.

Included with this soil in mapping are 10 percent Krebs and Olex soils and 5 percent Willis, Roloff, and Sagehill soils.

Permeability of the Blalock soil is moderate. Effective rooting depth is 10 to 20 inches. Available water capacity is 1.5 to 3.5 inches. Water supplying capacity is 5 to 6.5 inches. Runoff is slow, and the hazard of erosion is slight.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. On severely deteriorated range, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

This soil is limited for most community uses because of depth to the cemented pan and slope. Design modifications are needed if this soil is used for sanitary facilities, dwellings, and small buildings. This soil is limited for most recreational uses because of depth to the pan.

This is in capability subclass VIe.

5B—Condon and Valby silt loams, 1 to 7 percent slopes. These moderately deep, well drained soils are on uplands. These soils formed in loess mixed with some ash and are underlain by basalt. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

The Condon and Valby soils are not in a definite pattern. Either or both soils can occupy a mapped area.

Included with these soils in mapping are 10 percent Rhea soils and 10 percent Bakeoven and Lickskillet soils.

Typically, the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of erosion is slight.

Typically, the surface layer of the Valby soil is very dark brown silt loam 9 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 9 inches thick, and the lower part of the subsoil is dark brown silt loam about 5 inches thick. The upper part of the substratum is dark brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, brown silt loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Valby soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all areas of these soils are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main needs in managing these soils for crops are the protection of the soils from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage in the more nearly level areas and contour tillage and diversions in the steeper areas are desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on these soils is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. A variety of perennial forbs occur throughout the stand. A few shrubs are in the stand.

When range deteriorates on these soils, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or are greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are suitable practices. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use these soils in spring and fall, when plants are green and succulent. Most areas of these soils also provide food for small animals and game birds.

These soils are limited for community uses because of depth to bedrock. Design modifications are needed if these soils are used for dwellings, small buildings, and sanitary facilities. This unit has no major limitations for recreational facilities. Leveling of the upper part of slopes is needed in places for playgrounds.

These soils are in capability subclass IIIs dryland.

5C—Condon and Valby silt loams, 7 to 12 percent slopes. These moderately deep, well drained soils are on uplands. These soils formed in loess mixed with some ash and are underlain by rock. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

The Condon and Valby soils are not in a definite pattern. Either or both of these soils can occupy a mapped area.

Included with these soils in mapping are 10 percent Rhea soils and 10 percent Bakeoven and Lickskillet soils.

Typically, the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Typically the surface layer of the Valby soil is very dark brown silt loam about 9 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 9 inches thick, and the lower part of the subsoil is dark brown silt loam about 5 inches thick. The upper part of the substratum is dark brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, brown loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Valby soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of these soils are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main needs in managing these soils for crops are the protection of the soils from water erosion and the conservation of moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are generally needed to prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall or snowmelt. Response of wheat and barley to nitrogen fertilizer

is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on these soils is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. A variety of perennial forbs occur throughout the stand. Few shrubs are in the stand.

When range deteriorates on these soils, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or are greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are suitable practices. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use these soils in spring and fall, when plants are green and succulent. Most areas of these soils also provide food for small animals and game birds.

These soils are limited for community development and most recreational uses because of slope and depth of bedrock. Design modifications are needed if these soils are used for dwellings, small buildings, sanitary facilities, and recreational facilities.

These soils are in capability subclass IIIe dryland.

6D—Condon and Valby silt loams, 12 to 20 percent north slopes. These moderately deep, well drained soils are on uplands. These soils formed in loess mixed with some ash and are underlain by rock. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

The Condon and Valby soils are not in a definite pattern. Either or both soils can occupy a mapped area.

Included with these soils in mapping are 15 percent Rhea soils and 5 percent Bakeoven, Lickskillet, and Wrentham soils.

Typically, the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Typically, the surface layer of the Valby soil is very dark brown silt loam about 9 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 9 inches thick, and the lower part of the subsoil is dark brown silt loam about 5 inches thick. The upper part of the substratum is dark brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, brown silt loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Valby soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About half of the acreage of these soils is dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing these soils for crops are the protection of the soils from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on these soils is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. A variety of perennial forbs occur throughout the stand. Few shrubs are in the stand.

When range deteriorates on these soils, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and perennial forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated and annual weeds, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are suitable practices. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Most areas of these soils provide food for mule deer, small animals, and game birds.

These soils are severely limited for community uses because of slope and depth to bedrock. Extensive design modifications are needed if these soils are used for dwellings, small buildings, sanitary facilities, and recreational facilities.

These soils are in capability subclass IIIe dryland.

6E—Condon and Valby silt loams, 20 to 35 percent north slopes. These moderately deep, well drained soils

are on uplands. These soils formed in loess mixed with some ash and are underlain by basalt. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

The Condon and Valby soils are not in a definite pattern. Either or both soils can occupy a mapped area.

Included with these soils in mapping are 10 percent Rhea soils and 10 percent ash pockets and Wrentham soils.

Typically, the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is severe.

Typically, the surface layer of the Valby soil is very dark brown silt loam about 9 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 9 inches thick, and the lower part of the subsoil is dark brown silt loam about 5 inches thick. The upper part of the substratum is dark brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, brown silt loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Valby soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is severe.

Most areas of these soils are used for range and wildlife habitat. Some areas are used for wheat and barley in a grain-fallow rotation.

The native plant community on these soils is mainly bluebunch wheatgrass and Idaho fescue in about equal proportions. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Few shrubs are in the stand.

When range deteriorates on these soils, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and perennial forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, and annual weeds, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes are suitable practices. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

The main needs in managing these soils for crops are the protection of the soils from water erosion and the conservation of soil moisture for plant growth. If these soils are dryfarmed, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt.

These soils are limited for most community uses because of slope and depth to bedrock. Extensive and expensive design modifications are needed if these soils are used for dwellings, small buildings, sanitary facilities, and recreational facilities.

These soils are in capability subclass IVe dryland.

7D—Condon and Valby silt loams, 12 to 20 percent south slopes. These moderately deep, well drained soils are on uplands. These soils formed in loess mixed with some ash and are underlain by basalt. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

The Condon and Valby soils are not in a definite pattern. Either or both soils can occupy a mapped area.

Included with these soils in mapping are 20 percent Bakeoven and Lickskillet soils.

Typically, the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Typically, the surface layer of the Valby soil is very dark brown silt loam about 9 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 9 inches thick, and the lower part of the subsoil is dark brown silt loam about 5 inches thick. The upper part of the substratum is dark brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, brown silt loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Valby soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About half of the acreage of these soils is dryfarmed in a grain-fallow rotation. Wheat is the main crop, but barley is commonly grown, and some hay is produced. The remaining acreage is used for range, pasture, and wildlife habitat.

The main needs in managing these soils for crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. Stubble

mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen is applied to summer fallow in spring or fall. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on these soils is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. A variety of perennial forbs occur in minor amounts throughout the stand. Few shrubs are in the stand.

When range deteriorates on these soils, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, a large amount of ground is left bare, and the hazard of erosion is high. If range is in poor condition, seedbed preparation and seeding are suitable practices. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of these soils provide food for mule deer, small animals, and game birds.

These soils are severely limited for community and recreational uses because of slope and depth to bedrock. Extensive design modifications are needed if these soils are used for dwellings, small buildings, sanitary facilities, and recreational facilities.

These soils are in capability subclass IVe dryland.

7E—Condon and Valby silt loams, 20 to 30 percent south slopes. These moderately deep, well drained soils are on uplands. These soils formed in loess mixed with some ash and are underlain by basalt. Elevation is 1,600 to 3,100 feet. The average annual precipitation is 11 to 14 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

The Condon and Valby soils are not in a definite pattern. Either or both soils can occupy a mapped area.

Included with these soils in mapping are 15 percent Lickskillet and Bakeoven soils. Also included are 10 percent Condon and Valby soils that have slope of less than 20 percent or of more than 30 percent.

Typically, the surface layer of the Condon soil is very dark brown silt loam about 7 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown silt loam about 17 inches thick. It is underlain by fractured basalt.

Permeability of the Condon soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is severe.

Typically, the surface layer of the Valby soil is very dark brown silt loam about 9 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 9 inches thick, and the lower part of the subsoil is dark brown silt loam about 5 inches thick. The upper part of the substratum is dark brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, brown silt loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Valby soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is severe.

Most of the acreage of these soils is used for range and wildlife habitat. The remaining acreage is used for wheat and barley in a grain-fallow rotation.

The native plant community on these soils is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. A variety of perennial forbs occur in minor amounts throughout the stand. Few shrubs are in the stand.

When range deteriorates on these soils, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, a large amount of ground is left bare, and the hazard of erosion is high. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are suitable practices. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

The main needs in managing these soils for crops are the protection of the soils from water erosion and the conservation of soil moisture for plant growth. Where these soils are dryfarmed, stubble mulch tillage and minimum tillage used in combination with a grain-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt.

These soils are limited for community and recreational uses because of slope and depth to bedrock. Extensive and expensive design modifications are needed if these soils are used for dwellings, small buildings, sanitary facilities, and recreational facilities.

These soils are in capability subclass VIe dryland.

8—Dune land. This very deep, excessively drained miscellaneous area formed in sandy eolian material. Slope is variable, but ranges from 5 to 60 percent. Elevation is 300 to 900 feet. The average annual precipitation is 7 to 9 inches, and the average annual temperature is 49 to 54 degrees F. The average frost-free period

is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer and substratum are grayish brown or brown loamy sand, sand, or fine sand to a depth of 60 inches or more.

Included with this miscellaneous area in mapping are 15 percent Quincy, Sagehill, and Taunton soils.

Permeability of Dune land is rapid or very rapid. Available water capacity is 2 to 5 inches. Water supplying capacity is 2 to 3 inches. Effective rooting depth is about 60 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high, and unstabilized dunes are continually moved by the prevailing wind.

Areas of this map unit are used mainly for wildlife habitat.

Dune land is nearly void of vegetation and is not suitable for grazing. Improved perennial grasses and nursery-grown plants or clones of Volga wildrye, planted 20 inches apart in rows spaced 20 inches apart, help stabilize the dunes.

Dune land is severely limited for community and recreational uses by slope, rapid percolation, and soil blowing. Extensive design modifications are needed but generally are not practical for community and recreational uses.

This miscellaneous area is in capability subclass VIIIe.

9E—Gwinly very cobbly silt loam, 7 to 40 percent slopes. This shallow, well drained soil is on south- and west-facing exposures. It formed in colluvium from basalt. Average slope is about 25 percent. Elevation is 3,000 to 4,000 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free period is 100 to 120 days at 32 degrees and 120 to 150 days at 28 degrees.

Typically, the surface layer is very dark grayish brown very cobbly silt loam about 6 inches thick. The subsoil is very dark grayish brown and dark yellowish brown very cobbly silty clay loam and extremely cobbly clay about 8 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Rockly and Waha soils and 20 percent soils that are similar to this Gwinly soil but have bedrock at a depth of 20 to 24 inches.

Permeability of the Gwinly soil is slow. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 2.5 inches. Water supplying capacity is 6 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

Areas of this soil are used for grazing by livestock and for wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow occur in minor amounts throughout the stand. Shrubs are nearly absent.

When range deteriorates on this soil, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, cheatgrass and other low-value plants are dominant, and the hazard of soil erosion is high. Because of stones and shallow depth to rock, seedbed preparation and seeding of poor condition range are not practical on this soil.

Areas of this soil are used by mule deer in winter and early in spring when other areas are snow covered.

This soil is severely limited for community uses because of depth to rock, slope, high clay content, and high shrink-swell potential. Extensive design modifications are needed but generally are not practical for dwellings, small buildings, and sanitary facilities. This soil is severely limited for recreational uses because of stones, slope, and depth to rock.

This soil is in capability subclass VIIs.

10F—Gwinly-Rock outcrop complex, 40 to 70 percent slopes. This complex is on south-facing exposures. Average slope is about 55 percent. Elevation is 3,000 to 4,000 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free period is 100 to 120 days at 32 degrees and 120 to 150 days at 32 degrees.

This complex is about 55 percent Gwinly soil and 20 percent Rock outcrop.

Included with this complex in mapping are about 25 percent Waha and Rockly soils and soils that are similar to this Gwinly soil but have bedrock at a depth of 20 to 24 inches.

Typically, the surface layer of the Gwinly soil is very dark grayish brown very cobbly silt loam about 6 inches thick. The subsoil is very dark grayish brown and dark yellowish brown very cobbly silty clay loam and extremely cobbly clay about 8 inches thick. It is underlain by fractured basalt.

Permeability of the Gwinly soil is slow. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 2.5 inches. Water supplying capacity is 6 to 9 inches. Runoff is rapid, and the hazard of erosion is severe.

Rock outcrop consists of exposed areas of basalt.

Areas of this complex are used for grazing by livestock and for wildlife habitat.

The native plant community on the Gwinly soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs and a few shrubs occur in minor amounts.

When range deteriorates on this complex, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, the forage bunchgrasses are nearly eliminated, low-value plants are dominant, and the soil is subject to erosion. Because of stones and steep slopes, seedbed preparation and seeding of poor condition range are not practical.

Areas of this complex are used by mule deer in winter and early in spring when other areas are snow covered.

This complex is severely limited for community development because of depth to rock, slope, shrink-swell potential, and high clay content. Extensive design modifications are necessary but generally are not practical for dwellings, small buildings, and sanitary facilities. This complex is severely limited for recreational uses because of stones, slope, and depth to rock.

This complex is in capability subclass VIIs.

11—Hermiston silt loam. This very deep, well drained soil is on alluvial bottom lands along Rock Creek and Lonerock Creek. It formed in alluvium from loess and volcanic ash. Average slope is about 1 percent. Elevation is 800 to 1,500 feet. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 49 to 51 degrees F. The frost-free period is 130 to 170 days at 32 degrees and 170 to 200 days at 28 degrees.

Typically, the surface layer is very dark brown and very dark grayish brown silt loam about 31 inches thick. The substratum is dark brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Kimberly soils.

Permeability of the Hermiston soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 7.5 to 12.5 inches. Water supplying capacity is 8 to 13 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is rare.

Most areas of this soil are used for dryfarmed and irrigated crops. Hay and pasture are the main crops, although some winter wheat is grown. A few irregularly shaped areas are used for range.

The major needs in managing this soil for crops are the conservation of soil moisture for plant growth and the stabilization of streambanks against cutting by water. In irrigated areas proper timing and rates of applying irrigation water are important. Where water is available, irrigation is by flooding and sprinklers. Wheel-line and hand-line systems are most commonly used. Light, frequent applications of irrigation water are needed. A suitable cropping system in irrigated areas is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown continuously for more than 1 year, controlling weeds and diseases can be a serious concern in management. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone.

Areas of this soil on Lonerock Creek have a very gravelly and very cobbly substratum below a depth of 20 to 40 inches. Because of this, these areas have lower available water capacity than other areas. In most years the water supply in areas of these soils is not adequate for full-season irrigation. This, in addition to the short frost-free period, limits crops mainly to alfalfa-grass mixtures for hay and pasture.

In dryfarmed areas of wheat, stubble mulch tillage and minimum tillage used with a crop-fallow rotation help minimize erosion and help conserve soil moisture. Response of wheat to nitrogen fertilizer is low because of the low annual precipitation. Generally, 30 to 40 pounds of nitrogen fertilizer per acre is applied to summer fallow in spring or fall.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and riparian shrubs such as lilac or willow. Such vegetation also serves as important wildlife cover and should be considered in management of wildlife. Where streambank erosion is severe, practices such as rock riprap are needed in places in addition to plant cover.

Suitable grasses and legumes grown alone or in various combinations for dryfarmed pasture and hay are alfalfa, Siberian wheatgrass, crested wheatgrass, beardless wheatgrass, big bluegrass, intermediate wheatgrass, pubescent wheatgrass, and hard fescue.

The native plant community on this soil is dominantly basin wildrye and bluebunch wheatgrass. Sandberg bluegrass and such perennial forbs as lupine and western yarrow are prominent. Big sagebrush occurs sporadically.

When range deteriorates on this soil, basin wildrye and bluebunch wheatgrass decrease and Sandberg bluegrass and low-value forbs and shrubs increase.

Areas of this soil provide important food and cover for upland game birds, such as ring-necked pheasant and valley quail. Mule deer and small animals use areas of this soil for food and cover.

This soil is limited for many community uses because it is on flood plains of streams and subject to rare flooding. Design modifications are needed if this soil is used for sanitary facilities, dwellings, and small buildings. This soil has limitations for recreational uses because of rare flooding and dustiness.

This soil is in capability subclass IIc dryland and in class I irrigated.

12F—Kahler silt loam, bedrock substratum, 35 to 70 percent slopes. This deep, well drained soil is on foothills of the Blue Mountains. It formed in volcanic ash, loess, and basalt colluvium. Average slope is about 45 percent. Elevation is 3,700 to 4,300 feet. The mean annual precipitation is 18 to 20 inches, and the mean annual temperature is 43 to 45 degrees F. The frost-free period is 75 to 95 days at 32 degrees and 100 to 120 days at 28 degrees.

Typically, the surface layer is very dark brown and dark brown silt loam about 23 inches thick. The subsoil is dark brown cobbly silt loam about 12 inches thick. The substratum is dark brown cobbly loam about 15 inches thick. It is underlain by basalt.

Included with this soil in mapping are 1 percent Rock outcrop and 10 percent soils that have bedrock at a

depth of 60 inches or more. Also included is an area of about 143 acres in Lost Valley of a soil that has slopes of 5 to 15 percent.

Permeability of the Kahler soil is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 12 inches. Water supplying capacity is 12 to 16 inches. Runoff is rapid, and the hazard of erosion is severe.

This soil is used for timber (fig. 3), livestock grazing, wildlife habitat, and recreation.

Figure 3.—Douglas-fir on Kahler silt loam, bedrock substratum, 35 to 70 percent slopes.

This soil is suited to Douglas-fir and ponderosa pine. Based on a site index of 85, this soil is capable of producing about 5,080 cubic feet of merchantable timber from a fully stocked stand of 80-year old trees, or 35,750 board feet (International Rule, 1/8 inch kerf) of merchantable timber from a fully stocked stand of 100-year old trees (*7*).

Generally because of slope, the practical method of logging is by cable; however, some included areas that have slopes of 5 to 15 percent can be logged by tractor. In some areas, Rock outcrop interferes with logging. Steep slopes are also a concern to construction and maintenance of roads. The soil material provides fair subgrade for roads. The amount of ballast needed depends on the number and type of vehicles using the roads and the time of year that the road is used. Use of the road early in spring should be limited.

The native plant community on this soil is mixed fir-ponderosa pine forest, but is dominantly fir. The tree canopy cover is about 40 percent, and under this canopy only a small amount of forage is produced for domestic livestock. The foliar understory is dominated by elk sedge, which makes up about 40 percent, and a variety of shrubs, such as snowberry and rose, that make up about 2 percent each. Peavine is a prominent forb and makes up about 5 percent of the understory. In open-grown stands, elk sedge, pinegrass, Idaho fescue, and a variety of palatable forbs such as peavine provide considerable forage as long as the tree stand remains open.

Following fire or logging, broadcast seeding of grasses before fall is desirable. A major objective of seeding is to stabilize disturbed soil areas. Orchardgrass, timothy, hard fescue, and white clover are suitable for seeding.

Mule deer, small animals, and birds, including such game species as blue grouse and ruffed grouse, use areas of this soil for food and cover.

This soil is severely limited for community and recreational uses because of slope. The extensive design modifications which are needed generally are not practical for all community and recreational uses.

This soil is in capability subclass VIIe.

13—Kimberly fine sandy loam. This very deep, well drained soil is on alluvial bottom lands along Rock Creek and Willow creek. It formed in mixed alluvium. Average slope is about 1 percent. Elevation is 400 to 1,200 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 51 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. Next is about 13 inches of dark brown fine sandy loam. Below this, to a depth of 60 inches or more, is dark brown and very dark grayish brown fine sandy loam and sandy loam.

Included with this soil in mapping are 10 percent Powder soils and Xeric Torrifluvents and 5 percent Hermiston soils.

Permeability of the Kimberly soil is moderately rapid. Effective rooting depth is more than 60 inches. Available water capacity is 6 to 9 inches. Water supplying capacity is 8 to 11 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is rare.

Areas of this soil are used for irrigated crops. Hay and pasture are the main crops, although some winter wheat is grown. Some irregularly shaped areas are used for range.

The main needs in managing this soil for irrigated crops are proper timing and rate of application of irrigation water. Streambank stabilization against cutting by water is also important. Irrigation is by flooding and sprinklers. Wheel-line and hand-line systems are most commonly used. Because of the moderately rapid permeability and high rate of water consumption on this soil, light,

frequent applications of irrigation water are needed. A suitable cropping system in irrigated areas is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown more than 1 year, controlling weeds and diseases can be a serious concern in management. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone. Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and riparian shrubs such as lilac or willow. Such vegetation also serves as important wildlife cover and should be considered in wildlife management. Where streambank erosion is severe, practices such as rock riprap are needed in places in addition to plant cover.

Areas of this soil provide important food and cover for upland game birds, such as ring-necked pheasant and valley quail. Mule deer and small animals use areas of this soil for food and cover.

This soil is limited for community uses because it is on flood plains of streams and subject to rare flooding. Design modifications are needed if this soil is used for sanitary facilities, dwellings, and small buildings. This soil is well suited to recreational uses, except for campgrounds where flooding may be a problem.

This soil is in capability class I irrigated.

14B—Krebs silt loam, 2 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in loess and old waterlaid sediment. Average slope is 3 percent. Elevation is 500 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown, brown, and pale brown silty clay loam and silty clay about 26 inches thick. The substratum is pale brown silty clay loam about 12 inches thick. It is underlain by partially decomposed diatomite.

Included with this soil in mapping are 10 percent Olex and Roloff soils and 5 percent Taunton, Sagehill, and Blalock soils.

Permeability of the Krebs soil is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5.5 to 10 inches. Water supplying capacity is 6 to 8 inches. Runoff is slow, and the hazard of water erosion is slight.

Areas of this soil are used for range and wildlife habitat. Where irrigation water is available, this soil is moderately suited to irrigated crops. Because of slow permeability in this soil, application of irrigation water needs to be carefully regulated to prevent runoff.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slow permeability, depth to rock, low strength, and high shrink-swell potential. Design modifications are needed if this soil is used for sanitary facilities, dwellings, small buildings, and roads and streets. This soil is limited for recreational uses because of the dusty surface.

This soil is in capability subclass VIe.

14D—Krebs silt loam, 5 to 20 percent slopes. This deep, well drained soil is on uplands. It formed in loess and old waterlaid sediment. Average slope is 12 percent. Elevation is 500 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown, brown, and pale brown silty clay loam and silty clay about 26 inches thick. The substratum is pale brown silty clay loam about 12 inches thick. It is underlain by partially decomposed diatomite.

Included with this soil in mapping are 10 percent Olex and Roloff soils and 5 percent Taunton, Sagehill, and Blalock soils.

Permeability of the Krebs soil is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5.5 to 10 inches. Water supplying capacity is 6 to 8 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, the bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is severely limited for community uses because of slow permeability, slope, depth to rock, low strength, and high shrink-swell potential. Design modifications are needed if this soil is used for sanitary facilities, dwellings, small buildings, and roads and streets. This soil is limited for recreational uses because of slope and the dusty surface.

This soil is in capability subclass VIe.

14E—Krebs silt loam, 20 to 40 percent slopes. This deep, well drained soil is on uplands. It formed in loess and old waterlaid sediment. Average slope is 25 percent. Elevation is 500 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown, brown, and pale brown silty clay loam and silty clay about 26 inches thick. The substratum is pale brown silty clay loam about 12 inches thick. It is underlain by partially decomposed diatomite.

Included with this soil in mapping are 10 percent Olex and Roloff soils and 5 percent Taunton and Sagehill soils.

Permeability of the Krebs soil is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5.5 to 10 inches. Water supplying capacity is 6 to 8 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is severely limited for community development, sanitary facilities, and recreational uses because of steep slope.

This soil is in capability subclass VIe.

15E—Lickskillet very stony loam, 7 to 40 percent slopes. This shallow, well drained soil is on south- and west-facing exposures. It formed in loess and colluvium from basalt. Average slope is 20 percent. Elevation is 250 to 3,500 feet. The average annual precipitation is 10 to 14 inches, and the average annual temperature is 47 to 52 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 210 days at 28 degrees.

Typically, the surface layer is dark brown very stony loam about 3 inches thick. The subsoil is dark brown very gravelly loam and very gravelly clay loam about 12 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 20 percent Bakeoven soils and Rock outcrop and 10 percent Mikkalo, Condon, Valby, Morrow, and Wrentham soils.

Permeability of the Lickskillet soil is moderate. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 3 inches. Water supplying capacity is 2 to 5 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for grazing by livestock and for wildlife habitat.

The main concern in managing this soil is the maintenance of the plant cover to help control water erosion.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, a large amount of ground is left bare, and the potential for soil erosion is high. Because the soil is shallow and stony, seedbed preparation and seeding of poor condition range generally are not practical.

This soil is severely limited for community and recreational uses because of depth to bedrock, stoniness, and slope. The extensive design modifications which are necessary in most cases are not practical for the development of dwellings, small buildings, and sanitary facilities.

This soil is in capability subclass VIIs.

16F—Lickskillet-Rock outcrop complex, 40 to 70 percent slopes. This complex is on south-facing exposures on uplands. Elevation is 250 to 3,000 feet. Average slope is about 50 percent. The average annual precipitation is 10 to 14 inches, and the average annual temperature is 47 to 52 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 210 days at 28 degrees.

This complex is about 55 percent Lickskillet soil and 25 percent Rock outcrop.

Included with this complex in mapping are 15 percent Bakeoven soils and Rubble land and 5 percent Nansene and Wrentham soils.

Typically, the surface layer of the Lickskillet soil is dark brown very stony loam about 3 inches thick. The subsoil is dark brown very gravelly loam and very gravelly clay loam about 12 inches thick. It is underlain by fractured basalt.

Permeability of the Lickskillet soil is moderate. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 3 inches. Water supplying capacity is 2 to 5 inches. Runoff is rapid, and the hazard of erosion is high.

Rock outcrop consists of exposed areas of basalt bedrock.

Areas of this complex are used for grazing by livestock and for wildlife habitat.

The native plant community on the Lickskillet soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs and a few shrubs occur in minor amounts.

When range deteriorates on this complex, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, the forage bunchgrasses are nearly eliminated, low-value plants are dominant, the soil is subject to erosion, and a large amount of ground is left bare. Because of the very stony soil and very steep slopes, seedbed preparation and seeding of poor condition range are not practical.

This complex is severely limited for community and recreational uses because of shallow depth to bedrock, stoniness, and very steep slopes. The extreme design modifications which are necessary are rarely practical for the development of dwellings, small buildings, and sanitary facilities.

This complex is in capability subclass VIIs.

17B—Mikkalo silt loam, 2 to 7 percent slopes. This moderately deep, well drained soil is on uplands, mainly between Rock Creek and Hog Creek. It formed in loess. Average slope is about 4 percent. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown silt loam about 11 inches thick. The subsoil is dark brown silt loam about 24 inches thick. The substratum is brown silt loam about 3 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Ritzville and Willis soils and 5 percent Lickskillet and Bakeoven soils.

Permeability of the Mikkalo soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. A few areas are used for irrigated hay and pasture, and some areas are used for range and wildlife habitat.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage in the more nearly level areas and contour tillage and diversions on the steeper areas are desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass.

The native plant community on this soil is dominantly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of depth to bedrock. Design modifications are needed for the development of dwellings, small buildings, and sanitary facilities. This soil is limited for recreational facilities because of the dusty surface and depth to bedrock.

This soil is in capability subclass IIIe dryland.

17C—Mikkalo silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on uplands, mainly between Rock Creek and Hog Creek. It formed in loess. Average slope is about 9 percent. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The average frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown silt loam about 11 inches thick. The subsoil is dark brown silt loam about 24 inches thick. The substratum is brown silt loam about 3 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Ritzville and Willis soils and 5 percent Lickskillet and Bakeoven soils.

Permeability of the Mikkalo soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. A few areas are used for irrigated hay and pasture. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are generally needed to prevent erosion that results from rapid runoff during periods of high-intensity rainfall or snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass.

The native plant community on this soil is dominantly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slope and depth to bedrock. Modifications in design are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IIIe dryland.

17D—Mikkalo silt loam, 12 to 20 percent slopes. This moderately deep, well drained soil is on uplands, mainly between Rock Creek and Hog Creek. It formed in loess. Average slope is about 15 percent. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown silt loam about 11 inches thick. The subsoil is dark brown silt loam about 24 inches thick. The substratum is brown silt loam about 3 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Ritzville and Willis soils and 10 percent Lickskillet and Bakeoven soils.

Permeability of the Mikkalo soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing this soil for dryfarmed crops are protection of the soil from water erosion and conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryland hay and pasture suitable grasses and legumes grown alone or in combination are alfalfa, crested wheatgrass, Siberian Wheatgrass, beardless wheatgrass, and big bluegrass.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, game birds, and songbirds.

This soil is limited for community and recreational uses because of slope and depth to bedrock. Design modifications are needed for the development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IVe dryland.

17E—Mikkalo silt loam, 20 to 40 percent slopes. This moderately deep, well drained soil is on south-facing exposures on uplands, mainly between Rock Creek and Hog Creek. It formed in loess. Average slope is about 30 percent. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown silt loam about 11 inches thick. The subsoil is dark brown silt loam about 24 inches thick. The substratum is brown silt loam about 3 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are about 15 percent Ritzville and Warden soils and 15 percent Lickskillet soils.

Permeability of the Mikkalo soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water capacity is 6.5 to 8 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. Some areas are dryfarmed in a grain-fallow rotation. Wheat and barley are the main crops.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the bluebunch wheatgrass is nearly eliminated, a large amount of ground is left bare, and the potential for soil erosion is high. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt.

This soil is severely limited for community and recreational uses because of slope. Extensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreation areas.

This soil is in capability subclass IVe dryland.

18B—Morrow silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on uplands, mainly south of Thirtymile Creek. It formed in loess. Elevation is 2,600 to 3,500 feet. Average slope is about 4 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is very dark grayish brown and brown silty clay loam about 11 inches thick. The substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 10 percent Bakeoven and Lickskillet soils.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main need in managing this soil for dryfarmed crops is the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, cross-slope tillage on the more nearly level areas and contour tillage and diversions on the steeper areas are desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, intermediate wheatgrass, beardless wheatgrass, tall wheatgrass, and hard fescue.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and fall when plants are green and succulent. Also, most areas of this soil provide food for small animals and game birds.

This soil is limited for community developments and recreational facilities because of depth to rock, moderately slow permeability, and moderate shrink-swell potential. Design modifications are needed for community development, sanitary facilities, and recreational areas.

This soil is in capability subclass IIIe dryland.

18C—Morrow silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on uplands, mainly south of Thirtymile Creek. It formed in loess. Average slope is about 9 percent. Elevation is 2,600 to 3,500 feet. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is very dark grayish brown and brown silty clay loam about 11 inches thick. The substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 10 percent Lickskillet and Bakeoven soils.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage, contour tillage and diversions are generally needed to prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall or snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, intermediate wheatgrass, beardless wheatgrass, tall wheatgrass, and hard fescue.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and fall when plants are green and succulent. Also, most areas of this soil provide food for small animals and game birds.

This soil is limited for community developments and recreational facilities because of depth to rock, slope, moderately slow permeability, and moderate shrink-swell potential. Design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IIIe dryland.

19D—Morrow silt loam, 12 to 20 percent north slopes. This moderately deep, well drained soil is on uplands, mainly south of Thirtymile Creek. It formed in loess. Average slope is about 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is very dark grayish brown and brown silty clay loam about 11 inches thick. The substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 5 percent ash deposits, 10 percent soils that are similar to the Morrow soil but have depth of more than 40 inches, and 10 percent Lickskillet and Bakeoven soils.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt. Response of wheat and barley to nitro-

gen fertilizer is low because of the low annual precipitation. Generally, 25 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryfarmed hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, intermediate wheatgrass, beardless wheatgrass, tall wheatgrass, and hard fescue.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs are throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and the annual grasses and low-value forbs, such as common teasel and bull thistle, are dominant. If range is in poor condition, seedbed preparation and seeding to grass are practical measures. Intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa are suitable for seeding.

Mule deer use areas of this soil in summer and late in fall because of the cooler temperatures and proximity to cover. Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slope, depth to bedrock, moderately slow permeability, and shrink-swell potential. Extensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IIIe dryland.

19E—Morrow silt loam, 20 to 35 percent north slopes. This moderately deep, well drained soil is on uplands, mainly south of Thirtymile Creek. It formed in loess. Average slope is about 25 percent. Elevation is 2,600 to 3,500 feet. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is very dark grayish brown and brown silty clay loam about 11 inches thick. The substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 20 percent soils that are similar to the Morrow soil but have depth of more than 40 inches, 10 percent Wrentham soils, and 5 percent ash deposits.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. Some areas are used to grow wheat and barley in a grain-fallow rotation.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and the annual grasses and low-value forbs, such as common teasel and bull thistle, are dominant. If range is in poor condition, seedbed preparation and seeding of more gentle slopes to grass are practical measures. Intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa are suitable for seeding dryland.

Mule deer use areas of this soil in summer and late in fall because of the cooler temperatures and proximity to cover. Game birds and small animals also use these areas.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt.

This soil is severely limited for community uses because of slope, depth to rock, and moderately slow permeability. Extensive design modifications are needed for development of dwellings, small buildings, and sanitary facilities. This soil is severely limited for recreational facilities because of slope.

This soil is in capability subclass IVe dryland.

20D—Morrow silt loam, 12 to 20 percent south slopes. This moderately deep, well drained soil is on uplands, mainly south of Thirtymile Creek. It formed in loess. Average slope is about 15 percent. Elevation is 2,600 to 3,500 feet. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is very dark grayish brown and brown silty clay loam about 11 inches thick. The substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 10 percent soils that are similar to the Morrow soil but have depth of less than 20 inches and 10 percent Lickskillet and Bakeoven soils.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium to rapid, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Wheat is the main crop, barley is common, and some hay is produced. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing this soil for dryfarmed crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryfarmed hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on this soil is mainly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf, balsamroot, milkvetch, and yarrow occur throughout the stand in minor amounts. Shrubs are nearly absent.

When range deteriorates on this soil, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, cheatgrass and other low-value plants are dominant and the potential for soil erosion is high. Seedbed preparation and seeding to grass are practical measures if range is in poor condition. Beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa are suitable for seeding dryland.

Areas of this soil are used by mule deer in winter and early in spring when areas of other soils are snow covered. Most areas of this soil provide food for a variety of small animals and game birds. The wildlife habitat should be considered in managing this soil.

This soil is limited for community uses because of slope, depth to rock, and moderately slow permeability. Extensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IIIe dryland.

21E—Morrow-Lickskillet complex, 20 to 30 percent slopes. These soils are on south-facing exposures on uplands, mainly south of Thirtymile Creek. Elevation is 2,600 to 3,500 feet. Average slope is about 25 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

This complex is about 70 percent Morrow soil and 15 percent Lickskillet soil.

Included with these soils in mapping are 15 percent soils that are similar to the Morrow soil but have basalt at a depth of 16 to 20 inches.

Typically, the surface layer of the Morrow soil is very dark brown silt loam about 9 inches thick. The subsoil is very dark grayish brown and brown silty clay loam about 11 inches thick. The substratum is brown silt loam about 18 inches thick. It is underlain by fractured basalt.

Permeability of the Morrow soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Typically, the surface layer of the Lickskillet soil is dark brown very stony loam about 3 inches thick. The subsoil is dark brown very gravelly loam and very gravelly clay loam about 12 inches thick. It is underlain by fractured basalt.

Permeability of the Lickskillet soil is moderate. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 3 inches. Water supplying capacity is 2 to 5 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this complex are used for range and wildlife habitat. Some areas are dryfarmed in a grain-fallow rotation. Wheat and barley are grown.

The native plant community on the Morrow soil is mainly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow occur throughout the stand in minor amounts. Shrubs are nearly absent. The native plant community on the Lickskillet soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs and a few shrubs occur in minor amounts.

When range deteriorates on this complex, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, cheatgrass and other low-value plants are dominant and the potential for soil erosion is high. Seedbed preparation and seeding of the more gentle and less stony slopes are practical if range is in poor condition. Beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa are suitable for seeding dryland.

Areas of this complex are used by mule deer in winter and early in spring when other soils are covered with snow. The wildlife habitat should be considered in managing areas of this complex.

In areas of this complex that are farmed, only the Morrow soil is used to produce crops. The interspersed areas of Lickskillet soil are not cultivated. The main

needs in managing the Morrow soil are protection of the soil from water erosion and the conservation of soil moisture for plant growth. Areas of Morrow soil that are dryfarmed need stubble mulch tillage and minimum tillage in combination with a crop-fallow rotation to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt.

This complex is severely limited for community uses because of slope and depth to rock. Extensive design modifications are needed for development of dwellings, small buildings, and sanitary facilities. This complex is severely limited for recreational facilities because of slope and depth to rock.

This complex is in capability subclass IVe dryland.

22F—Nansene silt loam, 35 to 70 percent slopes. This very deep, well drained soil is on north-facing exposures, mainly along the Columbia River and Rock Creek. It formed in loess. Average slope is 50 percent. Elevation is 300 to 1,900 feet. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 48 to 52 degrees F. The frost-free period is 140 to 170 days at 32 degrees and 170 to 200 days at 28 degrees.

Typically, the surface layer is very dark brown and dark brown silt loam about 21 inches thick. The subsoil is dark brown and brown silt loam about 24 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 20 percent Ritzville, Rhea, and Wrentham soils and 5 percent Lickskillet soils and Rock outcrop.

Permeability of the Nansene soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 6.5 to 12 inches. Water supplying capacity is 8 to 12 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for grazing by livestock and for wildlife habitat.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a wide variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annual grasses and low-value forbs are dominant. Because of steep slopes, seedbed preparation and seeding of poor condition range are not practical.

Mule deer use areas of this soil in summer and late in fall because of the cooler temperatures and proximity to cover.

This soil is severely limited for community and recreation uses because of steep slopes. The extensive design modifications which are necessary generally are not practical for the development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass VIIe.

23B—Olex silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on high terraces north of Rock Creek. It formed in loess and very gravelly alluvial deposits. Average slope is about 3 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown gravelly silt loam about 12 inches thick. The upper part of the substratum is dark brown very gravelly silt loam about 8 inches thick, and the lower part of the substratum is calcareous, brown extremely gravelly silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Roloff and Krebs soils and 5 percent Blalock, Sagehill, and Willis soils.

Permeability of the Olex soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4.0 to 6.5 inches. Water supplying capacity is 6.5 to 8.0 inches. Runoff is slow, and the hazard of erosion is slight.

Areas of this soil are used for range and wildlife habitat. Where irrigation water is available, this soil is suited to such irrigated crops as wheat, corn, and alfalfa hay.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of seepage. Design modifications are needed for sewage lagoons, septic tank absorption systems, and sanitary landfills. This soil is suited to other community and recreational uses.

This soil is in capability subclass VIe.

23C—Olex silt loam, 5 to 12 percent slopes. This very deep, well drained soil is on high terraces north of Rock Creek. It formed in loess and very gravelly alluvial deposits. Average slope is about 9 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown gravelly silt loam about 12 inches thick. The upper part of the substratum is dark brown very gravelly silt loam about 8 inches thick, and the lower part of the substratum is calcareous, brown extremely gravelly silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Roloff and Krebs soils and 5 percent Blalock, Sagehill, and Willis soils.

Permeability of the Olex soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4.0 to 6.5 inches. Water supplying capacity is 6.5 to 8.0 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Areas of this soil are used for range and wildlife habitat. Where irrigation water is available, this soil is suited to such irrigated crops as wheat, corn, and alfalfa hay.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of seepage and slope. It is limited for dwellings and small buildings and recreational facilities because of slope. Design modifications are needed in places.

This soil is in capability subclass VIe.

23D—Olex silt loam, 12 to 20 percent slopes. This very deep, well drained soil is on high terraces north of Rock Creek. It formed in loess and very gravelly alluvial deposits. Average slope is about 15 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown gravelly silt loam about 12 inches thick. The upper part of the substratum is dark brown very gravelly silt loam about 8 inches thick, and the lower part of the substratum is calcareous, brown extremely gravelly silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Roloff and Krebs soils.

Permeability of the Olex soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4.0 to 6.5 inches. Water supplying capacity is 6.5 to 8.0 inches. Runoff is medium, and the hazard of erosion is moderate.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of seepage and slope and for other community and recreational uses because of slope. Design modifications are necessary in places.

This soil is in capability subclass VIe.

24D—Olex gravelly silt loam, 5 to 20 percent slopes. This very deep, well drained soil is on uplands north of Rock Creek. It formed in loess and very gravelly alluvial deposits. Average slope is about 12 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 9 to 11 inches, and the average temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 30 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown gravelly silt loam about 12 inches thick. The subsoil is brown gravelly and very gravelly silt loam about 12 inches thick. The upper part of the substratum is brown very gravelly silt loam about 18 inches thick, and the lower part of the substratum is calcareous, brown extremely gravelly silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Roloff and Krebs soils and 5 percent Blalock, Sagehill, and Willis soils.

Permeability of the Olex soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 6.5 inches. Water supplying capacity is 6.5 to 8.0 inches. Runoff is medium, and the hazard of erosion is moderate.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of seepage and slope. It is limited for other community uses because of slope and for recreational facilities because of slope, small stones, and a dusty surface. Design modifications are necessary in places.

This soil is in capability subclass VIe.

24E—Olex gravelly silt loam, 20 to 40 percent slopes. This very deep, well drained soil is on uplands north of Rock Creek. It formed in loess and very gravelly alluvial deposits. Average slope is about 25 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown and dark brown gravelly silt loam about 12 inches thick. The subsoil is brown gravelly and very gravelly silt loam about 12 inches thick. The upper part of the substratum is brown very gravelly silt loam about 18 inches thick, and the lower part of the substratum is calcareous, brown extremely gravelly silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Roloff and Krebs soils and 5 percent Blalock, Sagehill, and Willis soils.

Permeability of the Olex soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 6.5 inches. Water supplying capacity is 6.5 to 8.0 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, a large amount of ground is left bare, and the potential for soil erosion is high. Because the soil is very gravelly and steep, seedbed preparation and seeding of poor condition range generally are not practical.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is severely limited for community uses and recreational facilities because of slope. The extensive design modifications which are necessary generally are not practical.

This soil is in capability subclass VIIe.

25D—Olex-Roloff complex, 5 to 20 percent slopes. These soils are on uplands south of Arlington (fig. 4). Average slope is about 12 percent. Elevation is 700 to 1,000 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Figure 4.—A typical area of Olex-Roloff complex, 5 to 20 percent slopes.

This complex is about 55 percent Olex soil and 25 percent Roloff soil.

Included with these soils in mapping are about 10 percent areas of very stony, very shallow soils. Also included are about 10 percent soils that are similar to the Olex soil, but have less than 35 percent coarse fragments in the 10- to 40-inch control section.

Typically, the surface layer of the Olex soil is very dark grayish brown and dark brown gravelly silt loam about 12 inches thick. The subsoil is brown gravelly and very gravelly silt loam about 12 inches thick. The upper part of the substratum is brown very gravelly silt loam about 18 inches thick, and the lower part of the substratum is calcareous, brown extremely gravelly silt loam to a depth of 60 inches or more.

Permeability of the Olex soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 6.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is medium, and the hazard of erosion is moderate.

Typically, the surface layer of the Roloff soil is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark brown silt loam about 9 inches thick. The substratum is dark brown silt loam about 7 inches thick. It is underlain by fractured bedrock.

Permeability of the Roloff soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

Areas of this complex are used for range and wildlife habitat.

The main concern in managing these soils is maintenance of plant cover to help control water erosion and soil blowing.

The native plant community on the Olex soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand. The native plant community on the Roloff soil is mainly needleandthread, bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, Columbia milkvetch, and western yarrow. Big sagebrush occurs in minor amounts.

When range deteriorates on this complex, the productive bunchgrasses decrease and Sandberg bluegrass and low-value forbs and grasses increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, a large amount of ground is left bare, and the potential for water erosion and soil blowing is moderate. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this complex provide food for mule deer, small animals, and game birds.

The Olex soil in this complex is limited for sanitary facilities because of seepage and slope. It is limited for other community uses because of slope and for recreational facilities because of slope, and the gravelly, dusty surface. The Roloff soil is limited for many community uses because of slope and depth to rock and for recreational facilities because of slope and dustiness. Design modifications are necessary in places.

The Olex soil in this complex is in capability subclass VIe. The Roloff soil is in capability subclass VIs.

26—Powder silt loam. This very deep, well drained soil is on alluvial bottom lands along Rock Creek and Willow Creek. It formed in alluvium derived from loess and volcanic ash. Average slope is 1 percent. Elevation is 600 to 2,000 feet. The average annual precipitation is 8 to 12 inches, and the average annual temperature is 49 to 51 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 200 days at 28 degrees.

Typically, the surface layer is dark brown and very dark grayish brown silt loam about 13 inches thick. The subsoil is very dark grayish brown silt loam 13 inches thick. The substratum is very dark grayish brown and dark brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are about 10 percent Kimberly soils.

Permeability of the Powder soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 11 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is rare.

Areas of this soil are used for irrigated crops. Hay and pasture are the main crops, but some winter wheat is also grown.

The main needs in managing this soil for crops are the conservation of moisture for plant growth and the stabilization of streambanks against cutting by water. In irrigated areas, the proper timing and the rates of application of irrigation water are important. Water is generally applied by flooding and sprinklers. Wheel-line and hand-line systems are most commonly used. Because of the high rate of water consumption on this soil, light frequent applications of irrigation water are needed.

A suitable cropping system for irrigated crops is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown continuously for more than 1 year, controlling weeds and diseases can be a serious concern in management. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone.

Where bank cutting is a problem, streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and riparian shrubs such as lilac or willow. Such vegetation also serves as important wildlife cover and should be considered in wildlife management. Where streambank erosion is severe, other practices

such as rock riprap, are needed in places in addition to plant cover.

Areas of this soil provide important food and cover for upland game birds, such as ring-necked pheasant and valley quail. Mule deer and small animals use this soil for food and cover.

Because this soil is on flood plains of streams and is subject to rare flooding, it is limited for many community uses. Flooding and dustiness are limitations for most recreational uses.

This soil is in capability class I irrigated.

27B—Prosser-Rock outcrop complex, 1 to 5 percent slopes. This complex is adjacent to the Columbia River. Average slope is about 3 percent. Elevation is 400 to 450 feet. The average annual precipitation is 7 to 9 inches, and the average temperature is 52 to 54 degrees F. The frost-free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

This complex is about 60 percent Prosser soil and 20 percent Rock outcrop.

Included with this complex in mapping are 15 percent Roloff and Quincy soils and 5 percent Olex soils.

Typically, the surface layer of the Prosser soil is dark brown silt loam about 3 inches thick. The subsoil is dark brown silt loam about 16 inches thick. The substratum is dark brown silt loam about 6 inches thick. It is underlain by basalt.

Permeability of the Prosser soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Rock outcrop consists of exposed areas of basalt.

Areas of this complex are used for range and wildlife habitat.

The native plant community on this complex is mainly needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread is generally dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow are common. Big sagebrush commonly occurs in minor amounts.

When range deteriorates on this complex, forage bunchgrasses decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe, as a result of fire or other disturbance, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding to grass are practical measures. The high hazard of soil blowing, however, presents a special management problem to seeding and seedbed preparation. Following a fire, drill seeding is a good method to help restore grasses. Grasses selected for dryland seeding should have strong seeding vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable. Grazing of native range by livestock should be limited mainly to winter months.

The soils in this complex support a small number of mule deer. Birds and small animals are common.

This complex is limited for community uses because of depth to rock. It is limited for recreational uses because of slope and dustiness.

This complex is in capability subclass VIs dryland.

28B—Quincy loamy fine sand, 0 to 5 percent slopes. This very deep, excessively drained soil is on terraces near the Columbia River east of Willow Creek. It formed in mixed sand. Average slope is 4 percent. Elevation is 600 to 700 feet. The average annual precipitation is 7 to 8 inches, and the average annual temperature is 52 to 54 degrees F. The frost-free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, this soil is very dark grayish brown loamy fine sand to a depth of 60 inches or more.

Permeability of the Quincy soil is rapid. Effective rooting depth is more than 60 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Included with this soil in mapping are about 15 percent Sagehill soils and Dune land.

Most areas of this soil are used for irrigated crops. The main crops are potatoes, annual wheat, corn, alfalfa hay, and pasture.

The main concerns in managing this soil for crops are the low available water capacity and the hazard of soil blowing. Where this soil is irrigated, water is applied by sprinklers. Center pivot systems are most commonly used. Light frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone of this rapidly permeable soil. A suitable cropping system is 1 year of wheat and 1 year of potatoes or 1 year of corn, 1 year of potatoes, and 3 to 5 years of alfalfa. If wheat or potatoes are grown consecutively for more than 1 year, controlling disease can be a serious concern in management.

Practices that help control soil blowing are winter cover crops; proper timing of irrigation, cultivation, and planting; minimum tillage; planting row crops perpendicular to the direction of the prevailing wind; double cropping; and stripcropping. Blowout areas can be treated by disking in straw mulch and seeding to adapted grasses. Soil blowing is critical when new land is broken out of rangeland for irrigated farming. Practices that are needed to overcome soil blowing at this time are complete development of the irrigation system before land is broken out, limiting the disturbance of rangeland to the period of June through November, and leaving plant cover intact in areas that are not cultivated.

This soil generally is well suited to community uses. Because of seepage, however, some modifications in the design of septic systems, sewage lagoons, and sanitary

landfills are required in places. This soil is limited for recreational uses because of the sandy surface.

This soil is in capability subclass IVs irrigated.

29D—Quincy-Rock outcrop complex, 1 to 20 percent slopes. This complex is on terraces and slopes adjacent to the Columbia River. Average slope is about 10 percent. Elevation is 250 to 500 feet. The average annual precipitation is 7 to 8 inches, and the average annual temperature is 52 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

This complex is about 60 percent Quincy soil and 25 percent Rock outcrop.

Included with this complex in mapping are about 15 percent Olex and Roloff soils; soils that are similar to this Quincy soil but are underlain by basalt at a depth of less than 60 inches; and Dune land.

Typically, the Quincy soil is very dark grayish brown loamy fine sand to a depth of 60 inches or more.

Permeability of the Quincy soil is rapid. Effective rooting depth is more than 60 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 2 to 3 inches. This soil is excessively drained. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Rock outcrop consists of exposed areas of basalt.

Areas of this complex are used for range and wildlife habitat. In most areas, the pattern and size of Rock outcrop are such that irrigated farming is not feasible.

The native plant community on this complex is mainly needleandthread, Indian ricegrass, antelope bitterbrush, Columbia milkvetch, and Carey balsamroot. Other shrubs, such as big sagebrush and rabbitbrush, occur in minor amounts.

When range deteriorates on this complex, Indian ricegrass decreases and needleandthread and low-value forbs increase. If deterioration is severe, cheatgrass invades and strongly dominates the stand, the hazard of soil blowing during the growing season is high, and the movement of sand in places is difficult to control. If range is in poor condition, maximum protection of the existing plant cover is needed. Standard methods of seedbed preparation and seeding present special problems because of the high hazard of soil blowing. Following fire, however, direct drill seeding to crested wheatgrass or Siberian wheatgrass is a good practice. Grazing by livestock should be limited mainly to winter months.

This complex supports a small number of mule deer. Waterfowl and other birds and small animals are common.

The Quincy soil in this complex is limited for community uses because of slope and seepage. It is limited for recreational uses because of the sandy surface.

This complex is in capability subclass VIIe dryland.

30B—Rhea silt loam, 1 to 7 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. Elevation is 1,600 to 3,100 feet. Average slope is 4 percent. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown and brown silt loam about 17 inches thick. The substratum is dark grayish brown, brown, and strong brown silt loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are 15 percent Condon and Valby soils and soils formed in volcanic ash, 5 percent Bakeoven and Lickskillet soils, and 15 percent soils that are similar to Rhea soils but have bedrock at a depth of 40 to 60 inches.

Permeability of the Rhea soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 11 to 12.5 inches. Water supplying capacity is 6 to 10 inches. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, cross-slope tillage in the more nearly level areas and contour tillage and diversions on the steeper areas are desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on this soil is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical meas-

ures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for recreational facilities because of the dusty surface. In places, playgrounds require leveling in the more sloping areas of this soil. This soil is suited for most community uses.

This soil is in capability subclass IIe dryland.

30C—Rhea silt loam, 7 to 12 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. Elevation is 1,600 to 3,100 feet. Average slope is 9 percent. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown and brown silt loam about 17 inches thick. The substratum is dark grayish brown, brown, and strong brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 15 percent Condon and Valby soils and soils formed in volcanic ash, 5 percent Bakeoven soils, and 15 percent soils that are similar to Rhea soils but have bedrock at a depth of 40 to 60 inches.

Permeability of the Rhea soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 11 to 12.5 inches. Water supplying capacity is 6 to 10 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are generally needed to prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall or snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on this soil is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and in fall when plants are green and succulent. Most areas provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slope and for recreational uses because of slope and dustiness. Design modifications are needed if this soil is used for dwellings, small buildings, and sanitary facilities. Major cutting and filling is needed in places for development of playgrounds.

This soil is in capability subclass IIIe dryland.

30D—Rhea silt loam, 12 to 20 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. Elevation is 1,600 to 3,100 feet. Average slope is 15 percent. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown and brown silt loam about 17 inches thick. The substratum is dark grayish brown, brown, and strong brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Condon and Valby soils and soils formed in volcanic ash, 5 percent Bakeoven soils, and 15 percent soils that are similar to Rhea soils but have a bedrock at a depth of 40 to 60 inches.

Permeability of the Rhea soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 11 to 12.5 inches. Water supplying capacity is 6 to 10 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. The remaining acreage is used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain

soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass.

The native plant community on this soil is dominated by about equal amounts of bluebunch wheatgrass and Idaho fescue. In places on slopes that face strongly to the north, Idaho fescue is dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and perennial forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated and annual weed, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed preparation and seeding to grass are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community and recreational uses because of slope. Extensive design modifications are needed if the soil is used for dwellings, small buildings, sanitary facilities, and most recreational facilities.

This soil is capability subclass IIIe dryland.

30E—Rhea silt loam, 20 to 40 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. Elevation is 1,600 to 3,100 feet. Average slope is 28 percent. The average annual precipitation is 11 to 13 inches, and the average annual temperature is 47 to 51 degrees F. The frost-free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The upper part of the subsoil is very dark grayish brown silt loam about 7 inches thick, and the lower part of the subsoil is dark brown and brown silt loam about 17 inches thick. The substratum is dark grayish brown, brown, and strong brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Condon and Valby soils, 5 percent soils formed in volcanic ash, 5 percent Lickskillet soils and Rock outcrop, and 10 percent soils that are similar to Rhea soils but have bedrock at a depth of 40 to 60 inches.

Permeability of the Rhea soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 11 to 12.5 inches. Water supplying capacity is 6 to 10 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. Some areas are used for wheat and barley in a grain-fallow rotation.

The native plant community on this soil is dominated by about equal amounts of bluebunch wheatgrass and Idaho fescue. In places on slopes that face strongly to the north, Idaho fescue is dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and perennial forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated and annual weeds, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Most areas of this soil provide food and cover for mule deer, small animals, and game birds.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt.

This soil is severely limited for community and recreational uses because of slope. Extensive design modifications are needed if this soil is used for dwellings, small buildings, sanitary facilities, and most recreational facilities.

This soil is in capability subclass IVe dryland.

31B—Ritzville very fine sandy loam, 2 to 7 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 4 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown very fine sandy loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 15 percent Warden and Willis soils, 10 percent Sagehill soils, and 5 percent Olex soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Some areas are irrigated. Winter wheat is the main crop, but some hay is grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from soil blowing and the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a grain-fallow rotation help maintain soil moisture. In addition, cross-slope tillage in the more nearly level areas and diversions in the steeper areas are desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

In irrigated areas, proper timing of irrigation is important. Water is applied by sprinklers, and center pivot systems are most commonly used. Light, frequent applications of water are needed. The rate at which irrigation water is applied needs to be monitored so that the infiltration rate of the soil is not exceeded and overirrigation does not result in runoff and erosion. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone. A suitable cropping system is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown consecutively for more than 1 year, controlling diseases and weeds can be a serious concern in management.

The hazard of soil blowing is moderate because of the very fine sandy loam texture of this soil and the frequent strong winds. Uncontrolled soil blowing causes soil loss by depositing coarse particles in drifts, hummocks, and dunes in fields and over roads. It causes crop damage by sandblasting, uprooting and uncovering of roots, and covering of plants with deposited material. It also causes loss of the applied fertilizers. Practices that help control soil blowing are winter cover crops; proper timing of irrigation, cultivation, and planting; minimum tillage; double cropping; and stripcropping. Blowout areas can be treated by disking in straw mulch and seeding to adapted grasses. Soil blowing is critical when new land is broken out of rangeland for irrigated farming. Practices that are needed to overcome soil blowing at this time are complete development of the irrigation system before land is broken out and leaving vegetation intact in areas that are not cropped.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such at clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for recreational facilities because of the dusty surface. Playgrounds require leveling in places. This soil has no serious limitations for community developments.

This soil is in capability subclass IVe dryland and capability subclass IIIe irrigated.

31C—Ritzville very fine sandy loam, 7 to 12 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 9 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown very fine sandy loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 15 percent Warden and Willis soils, 10 percent Sagehill soils, and 5 percent Olex soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Some areas are irrigated. Winter wheat is the main crop, but some hay is grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and soil blowing the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are generally needed to prevent erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds of nitrogen fertilizer per acre is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

In irrigated areas, proper timing of irrigation is important. Water is applied by sprinklers, and center pivot systems are most commonly used. Light, frequent appli-

cations of water are needed. The rate at which irrigation water is applied needs to be monitored so that the infiltration rate of the soil is not exceeded and overirrigation does not result in runoff and erosion. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone. A suitable cropping system is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown consecutively for more than 1 year, controlling weeds and diseases can be a serious concern in management.

The hazard of soil blowing is moderate because of the very fine sandy loam texture of this soil and the frequent strong winds. Uncontrolled soil blowing causes soil loss by depositing coarse particles in drifts, hummocks, and dunes in fields and over roads. It causes crop damage by sandblasting, uncovering and uprooting of plants, and covering of plants with deposited material. It also causes loss of the applied fertilizers. Practices that help control soil blowing are winter cover crops; proper timing of irrigation, cultivation, and planting; minimum tillage; double cropping; and stripcropping. Blowout areas can be treated by disking in straw mulch and seeding to adapted grasses. Soil blowing is critical when new land is broken out of rangeland for irrigated farming. Practices that are needed to overcome soil blowing at this time are complete development of the irrigation system before land is broken out and leaving vegetation intact in areas that are not cropped.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slope and for recreational uses because of slope and dustiness. Modifications in design are needed for the development of dwellings, sanitary facilities, and most recreational facilities.

This soil is in capability subclass IVe dryland and capability subclass IIIe irrigated.

31D—Ritzville very fine sandy loam, 12 to 20 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 17 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown very fine sandy loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 15 percent Warden and Willis soils, 10 percent Sagehill soils, and 5 percent Olex soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium to rapid, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Winter wheat is the main crop, but some hay is grown. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and soil blowing and the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Because of very fine sandy loam texture of this soil and frequent strong winds, the hazard of soil blowing is moderate. The risk of soil blowing can be reduced by such practices as minimum tillage and stubble mulch tillage.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community and recreational uses because of slope. Extensive modifications in design are needed for the development of dwellings, sanitary facilities, and most recreational facilities.

This soil is in capability subclass IVe dryland and capability subclass IIIe irrigated.

31E—Ritzville very fine sandy loam, 20 to 40 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 30 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown very fine sandy loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 15 percent Warden and Willis soils, 10 percent Sagehill soils, and 5 percent Olex soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Most areas of this soil are used for range and wildlife habitat. Some areas are used for wheat and barley in a grain-fallow rotation.

The native plant community on this soil is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Because of the very fine sandy loam texture and frequent strong winds, soil blowing is moderate. In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from runoff during periods of high-intensity rainfall and snowmelt. Blowout areas need special treatments, such as disking in straw mulch and seeding to adapted grasses.

Most areas of this soil provide food and cover for mule deer, small animals, and game birds.

This soil is severely limited for community and recreational uses because of slope. Extensive and expensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IVe dryland.

32A—Ritzville silt loam, 0 to 2 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 1 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 25 percent Mikkalo, Warden, and Willis soils and 5 percent Olex and Bakeoven soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Some areas are irrigated. Winter wheat is the main crop, but some hay is grown. Some areas are used for range and wildlife habitat.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring and fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

In irrigated areas, proper timing of irrigation is important. Water is applied by sprinklers, and center pivot systems are most commonly used. Light, frequent applications of irrigation water are needed. The rate at which irrigation water is applied needs to be monitored so that the infiltration rate of the soil is not exceeded and overirrigation does not result in runoff. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone. A suitable cropping system is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown consecutively for more than 1 year, controlling weeds and diseases can be a serious concern of management.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch

wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil has no serious limitations for community developments. Dustiness is a limitation for most recreation uses.

This soil is in capability subclass IIIc dryland and class I irrigated.

32B—Ritzville silt loam, 2 to 7 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 4 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 20 percent Mikkalo, Warden, and Willis soils, 5 percent Olex soils, and 1 percent volcanic ash deposits.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Some areas are irrigated. Winter wheat is the main crop, but some hay is grown (fig.5). Some areas are used for range and wildlife habitat.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, cross-slope tillage in the more nearly level areas and diversions in the steeper areas are desirable, particularly

Figure 5.—Alfalfa on Ritzville silt loam, 2 to 7 percent slopes, irrigated by a center-pivot sprinkler system.

where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

In irrigated areas, proper timing of irrigation is important. Water is applied by sprinklers, and center pivot systems are most commonly used. Light, frequent applications of water are needed. The rates at which irrigation water is applied needs to be monitored so that the infiltration rate of the soil is not exceeded and overirrigation does not result in runoff and erosion. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone. A suitable cropping system is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown consecutively for more than 1 year, controlling weeds and diseases can be a serious concern of management.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for recreational facilities because of the dusty surface. Playgrounds require leveling in places. This soil has no serious limitations for community developments.

This soil is in capability subclass IIIc dryland and subclass IIe irrigated.

32C—Ritzville silt loam, 7 to 12 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 9 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 25 percent Mikkalo, Warden, and Willis soils, and 5 percent Olex, Bakeoven, and Lickskillet soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Some areas are irrigated. Winter wheat is the main crop, but some hay is grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are generally needed to prevent erosion that results from runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

In irrigated areas, proper timing of irrigation is important. Water is applied by sprinklers, and center pivot systems are most commonly used. Light, frequent applications of water are needed. The rates at which irrigation water is applied needs to be monitored so that the infiltration rate of the soil is not exceeded and overirrigation does not result in runoff and erosion. Split applications of fertilizer are desirable because plant nutrients are readily leached from the root zone. A suitable cropping system is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown consecutively for more than 1 year, controlling weeds and diseases can be a serious concern to management.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slope and for recreational uses because of slope and dustiness. Modifications in design are needed for the

development of dwellings, sanitary facilities, and most recreational facilities.

This soil is in capability subclass IIIe dryland and capability subclass IIIe irrigated.

32D—Ritzville silt loam, 12 to 20 percent slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 15 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 25 percent Mikkalo, Warden, and Willis soils and 5 percent Olex, Bakeoven, and Lickskillet soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Some acreage, mainly small inclusions in the less sloping areas of this soil, is irrigated. Winter wheat is the main crop, but some hay is grown. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In irrigated areas, proper timing and rates of applying irrigation water are important.

In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community and recreational uses because of slope. Extensive modifications in design are needed for the development of dwellings, sanitary facilities, and most recreational facilities.

This soil is in capability subclass IVe dryland.

33E—Ritzville silt loam, 20 to 40 percent north slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 30 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 20 percent Mikkalo, Warden, and Willis soils and 5 percent Nansene soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. Some areas are used for wheat and barley in a grain-fallow rotation.

The native plant community on this soil is dominated by about equal amounts of bluebunch wheatgrass and Idaho fescue. In places on slopes that face strongly to the north, Idaho fescue is dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and perennial forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated and annual weeds, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Most areas of this soil provide food and cover for mule deer, small animals, and game birds.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results

from rapid runoff during high-intensity rainfall and snowmelt.

This soil is severely limited for community and recreational uses because of slope. Extensive and expensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IVe dryland.

34E—Ritzville silt loam, 20 to 40 percent south slopes. This deep, well drained soil is on uplands. It formed in loess. Elevation is 900 to 2,500 feet. Average slope is 30 percent. The average annual precipitation is 9 to 12 inches, and the average annual temperature is 48 to 51 degrees F. The frost-free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 12 inches thick. The subsoil is dark brown silt loam about 19 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 25 percent Mikkalo and Warden soils and 15 percent Olex and Lickskillet soils.

Permeability of the Ritzville soil is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. Some areas are used for wheat and barley in a grain-fallow rotation.

The native plant community on this soil is dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, a large amount of ground is left bare, and the potential for soil erosion is high. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation are necessary to minimize erosion and help maintain soil moisture. In addition, contour tillage helps prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt.

This soil is severely limited for community and recreational uses because of slope. Extensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IVe dryland.

35—Riverwash. This miscellaneous area is in narrow, irregular strips in the bends of stream channels and along drainageways. It consists of sand, well rounded gravel, stones, and boulders generally derived from basalt. Areas are 40 to 200 yards wide and 2 to 10 feet above normal level of the stream. Slope is 0 to 5 percent. Elevation is 850 to 2,500 feet. The average annual precipitation is 9 to 14 inches, and the average annual temperature is 46 to 52 degrees F. The average frost-free period is variable.

Riverwash is so variable that a typical profile is not described. Riverwash is underlain by bedrock at a depth of 20 to more than 60 inches.

Included with this miscellaneous area in mapping are 5 percent Kimberly soils and Xeric Torrifluvents.

Permeability of Riverwash is rapid to very rapid. Available water capacity and water supplying capacity are variable. Effective rooting depth is 20 to 60 inches. The hazard of water erosion is high. Areas of Riverwash are subject to overflow when the stream is flooded and are extremely droughty when the water level of the stream is low. During each overflow, new deposits of material are received or some material is removed.

Areas of this map unit are mainly used for wildlife habitat and as a possible source of gravel. Because of the hazard of flooding and the presence of small stones, Riverwash is severely limited for community and recreational developments. It is very limited for use as range.

This map unit is in capability subclass VIIIs.

36F—Rock outcrop-Rubble land complex, very steep. This complex is on uplands throughout the county. It consists of bare basalt outcrop or cobbly and stony rubble of various thickness. Slope ranges from 5 to more than 100 percent, although it is dominantly more than 40 percent. Elevation is 300 to 5,000 feet. The average annual precipitation is 7 to 25 inches, and the average annual temperature is 45 to 54 degrees F. The average frost-free period is 50 to 180 days at 32 degrees and 100 to 215 days at 28 degrees.

This complex is about 65 to 75 percent Rock outcrop and 20 to 30 percent Rubble land.

Included with this complex in mapping are 10 percent Lickskillet, Bakeoven, Gwinly, and Rockly soils and 5 percent Prosser, Quinton, Wrentham, and Roloff soils.

A typical profile for this complex is not described. Areas consist of bare basalt outcrop or cobbly and stony rubble of variable thickness.

Areas of this complex are used mainly for wildlife habitat. This complex has severe limitations for all community and recreational facilities because of slope, depth to

rock, and the presence of large stones. Except for small areas of included soils, it is limited for use as range. In many places, this complex forms a natural barrier to livestock.

This complex is in capability subclass VIIIs.

37D—Rockly very cobbly loam, 2 to 20 percent slopes. This very shallow, well drained soil is on ridgetops. It formed in loess, volcanic ash, and colluvium from basalt. Average slope is 5 percent. Elevation is 3,500 to 4,300 feet. The average annual precipitation is 14 to 20 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free period is 60 to 120 days at 32 degrees and 120 to 170 days at 28 degrees.

Typically, the surface layer is dark brown very cobbly loam about 3 inches thick. The subsoil is dark brown extremely cobbly loam about 4 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Waha and Gwinly soils.

Permeability of the Rockly soil is moderately slow. Effective rooting depth is 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is 1 to 4 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Nearly all areas of this soil are used for grazing by livestock.

The main need in managing this soil is the maintenance of plant cover to help control water erosion.

The native plant community on this soil is mainly very shallow rooted plants, such as Sandberg bluegrass and Oregon bluegrass. Small amounts of Idaho fescue and bluebunch wheatgrass are in places. Low-growing perennial forbs, such as pussytoes and phlox, are common.

When range deteriorates on this soil, small bluegrasses decrease and low-value forbs increase. If deterioration is severe, most plants are nearly eliminated and a barren rock pavement is formed. Because of very shallow depth to rock and the presence of stones, seedbed preparation and seeding are not practical.

Areas of this soil are used by mule deer in winter and early in spring as a source of green succulent food when other areas are snow covered. Areas also provide limited food and cover for small animals, game birds, and songbirds.

This soil is severely limited for community and recreational uses because of depth to bedrock and stoniness. Extensive design modifications are necessary and, in most cases, not practical for the development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass VIIs.

38A—Roloff silt loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on bedrock terraces near the Columbia River. It formed in loess. Average slope is 1 percent. Elevation is 250 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark brown silt loam about 9 inches thick. The substratum is dark brown silt loam about 7 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Olex, Taunton, Krebs, and Sagehill soils and 5 percent soils that are shallow and Rock outcrop.

Permeability of this Roloff soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight.

Areas of this soil are used for range and wildlife habitat. Where irrigation water is available, this soil has potential for irrigated wheat, alfalfa hay, and pasture.

The native plant community on this soil is mainly needleandthread, bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, Columbia milkvetch, and western yarrow. Big sagebrush occurs in minor amounts.

When range deteriorates on this soil, bluebunch wheatgrass and Indian ricegrass decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding to grass are suitable practices. Direct drill seeding following a fire is a good method of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for community uses because of depth of bedrock. Design modifications are needed if this soil is used for dwellings, small buildings, and sanitary facilities. This soil is limited for most recreational facilities because of dustiness and depth to rock.

This soil is in capability subclass IIIc dryland.

38B—Roloff silt loam, 2 to 7 percent slopes. This moderately deep, well drained soil is on bedrock terraces near the Columbia River. It formed in loess. Average slope is 5 percent. Elevation is 250 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 and 215 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark brown silt loam about 9 inches thick. The substratum is dark

brown silt loam about 7 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 15 percent Olex, Taunton, Krebs, and Sagehill soils and 5 percent soils that are shallow and Rock outcrop.

Permeability of this Roloff soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Ruoff is slow, and the hazard of erosion is slight.

Areas of this soil are used for range and wildlife habitat. Where irrigation water is available, this soil has potential for irrigated wheat, alfalfa hay, and pasture.

The native plant community on this soil is mainly needleandthread, bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, Columbia milkvetch, and western yarrow. Big sagebrush occurs in minor amounts.

When range deteriorates on this soil, bluebunch wheatgrass and Indian ricegrass decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding to dryland grasses are suitable practices. Direct drill seeding following a fire is a good method of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for community uses because of depth to bedrock. Design modifications are needed if this soil is used for dwellings, small buildings, and sanitary facilities. This soil has limitations for most recreational facilities because of dustiness. It is limited for playgrounds because of dustiness, slope, and depth to rock.

This soil is in capability subclass IIIc dryland.

38C—Roloff silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on bedrock terraces near the Columbia River. It formed in loess. Average slope is 10 percent. Elevation is 250 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees F.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark brown silt loam about 9 inches thick. The substratum is dark brown silt loam about 7 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 10 percent Olex and Sagehill soils and 10 percent soils that are shallow and Rock outcrop.

Permeability of this Roloff soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is medium, and the hazard of erosion is moderate.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly needleandthread, bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, Columbia milkvetch, and western yarrow. Big sagebrush occurs in minor amounts.

When range deteriorates on this soil, bluebunch wheatgrass and Indian ricegrass decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding to dryland grasses are suitable practices. Direct drill seeding following a fire is a good method of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for community uses because of depth of bedrock and slope. Dwellings, small buildings, and sanitary facilities must be designed to overcome these limitations. The soil is limited for most recreational uses because of slope and dustiness.

This soil is in capability subclass IIIe dryland.

39D—Roloff-Rock outcrop complex, 1 to 20 percent slopes. This complex is adjacent to the Columbia River. Average slope is about 5 percent. Elevation is 250 to 900 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 50 to 54 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

This complex is about 60 percent Roloff soil and 20 percent Rock outcrop.

Included with this complex in mapping are about 20 percent Olex, Krebs, Sagehill, Taunton, and Quincy soils.

Typically, the surface layer of the Roloff soil is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark brown silt loam about 9 inches thick. The substratum is dark brown silt loam about 7 inches thick. It is underlain by fractured basalt.

Permeability of the Roloff soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight.

Rock outcrop consists of exposed areas of basalt.

Areas of this complex are used mainly for range and wildlife habitat. Some small areas are used for irrigated permanent pasture, but in most areas irrigated farming is not feasible because of the Rock outcrop.

The native plant community on this complex is mainly needleandthread, bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, Columbia milkvetch, and western yarrow. Big sagebrush occurs in minor amounts.

When range deteriorates on this soil, bluebunch wheatgrass and Indian ricegrass decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding of the Roloff soil to dryland grasses are suitable practices. Direct drill seeding following a fire is a good method of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable. Grazing by livestock should be limited mainly to winter months.

Areas of this complex support a small number of mule deer. Birds and small animals are common.

This complex is limited for septic tank filter fields and sewage lagoons because of depth to rock. Designs for dwellings, commercial buildings, and streets and roads require some modification in places because of depth to rock. This complex is limited for most recreational facilities because of slope and dustiness.

This complex is in capability subclass VIs dryland.

40B—Sagehill fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and calcareous, lacustrine sediment. Average slope is 3 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark brown fine sandy loam and very fine sandy loam about 17 inches thick. The upper part of the substratum is dark grayish brown silt loam about 10 inches thick, and the lower part of the substratum is compact, grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Warden soils and 5 percent Taunton and Olex soils.

Permeability of the Sagehill soil is moderate. Effective rooting depth is restricted by stratified waterlaid silt, which is at a depth of 20 to 40 inches. Available water capacity of the rooting zone is 3 to 8 inches. Water supplying capacity is 5 to 7 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Most areas of this soil are used for range and wildlife habitat. A few areas are used for dryfarmed small grain. Where water is available, this soil is well suited to irrigated wheat, potatoes, corn, and alfalfa hay.

The main need in managing this soil is the maintenance of plant cover to minimize soil blowing. In irrigated areas, however, the rate of water application is restricted because of the compact substratum. If the rates of water application are not proper, oversaturation of the topsoil and ponding of the soil are hazards.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow occur in minor amounts. Big sagebrush and rubber rabbitbrush are common.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass, low-value forbs, and sagebrush increase (fig. 6). If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand. If range is in poor condition, seedbed preparation and seeding are practical measures. However, when this

Figure 6.—Poor condition range on Sagehill fine sandy loam, 2 to 5 percent slopes. In center of picture are ruts of the Oregon Trail.

soil is seeded to grass, soil blowing presents a special problem in management. Direct drill seeding following a fire is a good way of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested and Siberian wheatgrasses are suitable for seedling. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is generally well suited to community uses and most recreational uses. Slopes need to be levelled in places if this soil is used for playgrounds.

This soil is in capability subclass VIe.

40C—Sagehill fine sandy loam, 5 to 12 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and calcareous, lacustrine sediment. Average slope is 8 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark brown fine sandy loam and very fine sandy loam about 17 inches thick. The upper part of the substratum is dark grayish brown silt loam about 10 inches thick, and the lower part of the substratum is compact, grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Warden soils and 5 percent Taunton and Olex soils.

Permeability of the Sagehill soil is moderate. Effective rooting depth is restricted by the stratified waterlaid silt, which is at a depth of 20 to 40 inches. Available water capacity is 3 to 8 inches. Water supplying capacity is 5 to 7 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Most areas of this soil are used for range and wildlife habitat. A few areas are used for dryfarmed small grain. Where water is available, this soil has potential for irrigated wheat, potatoes, corn, and alfalfa hay.

The main concern in managing this soil is the maintenance of plant cover to minimize soil blowing. In irrigated areas, the rate of water application is restricted because of the compact substratum. If water is not applied at a proper rate, concerns of management are oversaturation of the topsoil, ponding in the less sloping areas, and runoff and erosion in the more sloping areas.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow occur in minor amounts. Big sagebrush and rubber rabbitbrush are common.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass, low-value forbs, and big sagebrush increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand. If range is in poor condition, seedbed preparation and seeding are practical measures. In areas in which this soil is seeded to grass, soil blowing presents a special problem to management. Direct drill seeding following a fire is a good way of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested and Siberian wheatgrasses are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for most community and recreational uses because of slope. In places, modifications in the design of facilities for these uses are necessary.

This soil is in capability subclass VIe.

40D—Sagehill fine sandy loam, 12 to 20 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and calcareous, lacustrine sediment. Average slope is 15 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark brown fine sandy loam and very fine sandy loam about 17 inches thick. The upper part of the substratum is dark brown silt loam about 10 inches thick, and the lower part of the substratum is compact, grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Warden soils and 5 percent Olex soils.

Permeability of the Sagehill soil is moderate. Effective rooting depth is restricted by the stratified waterlaid silt, which is at a depth of 20 to 40 inches. Available water capacity is 3 to 8 inches. Water supplying capacity is 5 to 7 inches. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is high.

Areas of this soil are used for range and wildlife habitat. Where water is available, this soil has potential for irrigated wheat, potatoes, corn, and alfalfa hay.

In irrigated areas, the rate of water application to this soil is restricted because of the compact subsoil. The proper rate of water application is needed to prevent oversaturation of the topsoil and to prevent runoff and the resulting erosion caused from too much irrigation water.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as

Carey balsamroot, wooly indianwheat, and western yarrow occur in minor amounts. Big sagebrush and rubber rabbitbrush are common.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass, low-value forbs, and big sagebrush increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand. If range is in poor condition, seedbed preparation and seeding are practical measures. In areas in which this soil is seeded to grass, soil blowing presents a special problem in management. Direct drill seeding following a fire is a good way of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested and Siberian wheatgrasses are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for most community and recreational uses because of slope. In places, modifications in the design and structure of facilities are needed.

This soil is in capability subclass VIe.

40E—Sagehill fine sandy loam, 20 to 40 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and calcareous, lacustrine sediment. Average slope is 25 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees F.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark brown fine sandy loam and very fine sandy loam about 17 inches thick. The upper part of the substratum is dark brown silt loam about 10 inches thick, and the lower part of the substratum is compact, grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Warden soils and 5 percent Olex soils.

Permeability of the Sagehill soil is moderate. Effective rooting depth is restricted by the stratified waterlaid silt, which is at a depth of 20 to 40 inches. Available water capacity is 3 to 8 inches. Water supplying capacity is 5 to 7 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow occur in minor amounts. Big sagebrush and rubber rabbitbrush are common.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass, low-value forbs, and big sagebrush increase. If deterioration is severe as a result of fire or other disturbances, cheatgrass and rabbitbrush commonly dominate the stand. If range is in poor condition, seedbed preparation and seeding on the more gentle slopes are practical measures. In areas in which this soil is seeded to grass, soil blowing presents a special problem in management. Direct drill seeding following a fire is a good way of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is severely limited for community and recreational uses because of slope.

This soil is in capability subclass VIe.

41B—Sagehill fine sandy loam, hummocky, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and calcareous, lacustrine sediment. Average slope is 3 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark brown fine sandy loam and very fine sandy loam about 17 inches thick. The upper part of the substratum is dark brown silt loam about 10 inches thick, and the lower part of the substratum is compact, grayish brown silt loam to a depth of 60 inches or more. In these soils, the surface layer has been eroded from some areas and redeposited as small mounds or hummocks.

Included with this soil in mapping are 10 percent Warden soils and 5 percent Taunton and Olex soils.

Permeability of the Sagehill soil is moderate. Effective rooting depth is restricted by the stratified waterlaid silt, which is at a depth of 20 to 40 inches. Available water capacity is 3 to 8 inches. Water supplying capacity is 5 to 7 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Areas of this soil are used for range and wildlife habitat. Where water is available, the soil has potential for irrigated wheat, potatoes, corn, and alfalfa hay, however, extensive leveling is needed for irrigated cropland.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow, occur in minor amounts. Big sagebrush and rubber rabbitbrush are common.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass, low-value forbs, and big sagebrush increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand. If range is in poor condition, seedbed preparation and seeding are practical measures. In areas in which this soil is seeded to grass, soil blowing presents a special problem in mangement. Direct drill seeding following a fire is a good way of restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested and Siberian wheatgrasses are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for community uses by the hummocky relief. Modifications in design are needed in places for small buildings, dwellings, and sanitary facilities. This soil is generally well suited to recreational uses, but extensive leveling is needed for playgrounds.

This soil is in capability subclass VIe.

41C—Sagehill fine sandy loam, hummocky, 5 to 12 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and calcareous, lacustrine sediment. Average slope is 8 percent. Elevation is 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark brown fine sandy loam and very fine sandy loam about 17 inches thick. The upper part of the substratum is dark brown silt loam about 10 inches thick, and the lower part of the substratum is compact, grayish brown silt loam to a depth of 60 inches or more. In these soils, the surface layer has been eroded from some areas and redeposited as small mounds or hummocks.

Included with this soil in mapping are 10 percent Warden soils and 5 percent Taunton and Olex soils.

Permeability of the Sagehill soil is moderate. Effective rooting depth is restricted by the stratified waterlaid silt, which is at a depth of 20 to 40 inches. Available water capacity is 3 to 8 inches. Water supplying capacity is 5 to 7 inches. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is high.

Areas of this soil are used for range and wildlife habitat. Where water is available, this soil has potential for irrigated wheat, potatoes, corn, and alfalfa hay. Extensive leveling is needed, however, for irrigated cropland.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and yarrow occur in minor amounts. Big sagebrush and rubber rabbitbrush are common.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass, low-value forbs, and big sagebrush increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand. If range is in poor condition, seedbed preparation and seeding are practical measures. In areas in which this soil is seeded to grass, soil blowing presents a special problem to management. Direct drill seeding following a fire is good in restoring grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested and Siberian wheatgrasses are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for community uses and most recreational uses because of slope. Modifications in design are needed for development of small buildings, dwellings, sanitary facilities, and recreational facilities.

This soil is in capability subclass VIe.

42B—Schrier silt loam, shaly substratum, 2 to 7 percent slopes. This deep, well drained soil is on bedrock terraces. It formed in loess and colluvium and alluvium derived from basalt and shale. Average slope is 5 percent. Elevation is 2,800 to 3,200 feet. The average annual precipitation is 14 to 16 inches, and the average annual temperature is 46 to 48 degrees F. The frost-free period is 100 to 130 days at 32 degrees and 130 to 160 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 20 inches thick. The subsoil is dark brown loam about 6 inches thick. The substratum is calcareous, brown loam about 24 inches thick. It is underlain by partially decomposed shale.

Included with this soil in mapping are 15 percent Tub, Ukiah, and Simas soils.

Permeability of the Schrier soil is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 8 to 10 inches. Water supplying capacity is 11 to 14 inches. Runoff is slow, and the hazard of water erosion is slight.

About half the acreage of this soil is used for dryfarming in a grain-fallow rotation. Wheat and barley for hay or grain are the main crops, but a few areas are irrigated for alfalfa hay and pasture. The remaining acreage is used for range and wildlife habitat.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation help maintain soil moisture. Response of wheat and barley to nitrogen fertilizer is low. Generally, 20 pounds

or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Considerations in managing irrigated crops are proper timing and rates of applying irrigation water.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor, and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Areas of this soil provide good habitat for mule deer, small animals, and game birds.

This soil is limited for some community uses because of depth to bedrock and permeability. Design modifications are needed for the development of dwellings, small buildings, and sanitary facilities. This soil is limited for recreational facilities because of the dusty surface.

This soil is in capability subclass IIIe dryland.

42C—Schrier silt loam, shaly substratum, 7 to 12 percent slopes. This deep, well drained soil is on bedrock terraces in the Lonerock area. It formed in loess and colluvium and alluvium derived from basalt and shale. Average slope is 9 percent. Elevation is 2,800 to 3,200 feet. The average annual precipitation is 14 to 16 inches, and the average annual temperature is 46 to 48 degrees F. The frost-free period is 100 to 130 days at 32 degrees and 130 to 160 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 20 inches thick. The subsoil is dark brown loam about 6 inches thick. The substratum is calcareous, brown loam about 24 inches thick. It is underlain by partially decomposed shale.

Included with this soil in mapping are 15 percent Ukiah, Tub, and Simas soils.

Permeability of the Schrier soil is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 8 to 10 inches. Water supplying capacity is 11 to 14 inches. Runoff is medium, and the hazard of erosion is moderate.

About 70 percent of the acreage of this soil is used for range and wildlife habitat. Most of the rest is used for dryfarmed grain or grain-hay in a grain-fallow rotation. A few areas are irrigated and used for alfalfa hay and pasture.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Sandberg bluegrass are prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue decreases and bluebunch wheatgrass and Sandberg bluegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass and low-value forbs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Intermediate wheatgrass, beardless wheatgrass, hard fescue, and alfalfa are suitable for dryland seeding.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage, minimum tillage, and diversions used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. Response of wheat and barley to nitrogen fertilizer is low. Generally, 20 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Considerations in managing irrigated crops are proper timing and rates of applying irrigation water.

Areas of this soil provide good habitat for mule deer, small animals, and game birds.

This soil is limited for community uses because of depth to bedrock, slope, and permeability. Design modifications are needed for the development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IIIe dryland.

43E—Simas very stony silt loam, 7 to 40 percent south slopes. This very deep, well drained soil is on uplands in the Lonerock area. It formed in loess and colluvium over waterlaid sediment. Average slope is 25 percent. Elevation is 2,800 to 3,200 feet. The average annual precipitation is 14 to 16 inches, and the averge annual temperature is 46 to 48 degrees F. The frost-free period is 100 to 130 days at 32 degrees and 130 to 160 days at 28 degrees.

Typically, the surface layer is very dark grayish brown very stony silt loam and very cobbly silty clay loam about 11 inches thick. The upper part of the subsoil is dark brown cobbly clay about 6 inches thick, and the lower part of the subsoil is calcareous, brown and dark brown cobbly clay about 25 inches thick. The substratum is calcareous, yellowish brown very cobbly clay loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Tub and Schrier soils and 10 percent Gwinly soils.

Permeability of the Simas soil is slow. Effective rooting depth is 24 to 36 inches. Available water capacity is 6 to 9 inches. Water supplying capacity is 8 to 12 inches. Runoff is medium to rapid, and the hazard of erosion is moderate.

Areas of this soil are used for range and wildlife habitat.

The main need in managing this soil is the maintenance of plant cover to help control water erosion.

The native plant community on this soil is mainly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow occur throughout the stand in minor amounts. Shrubs are nearly absent.

When range deteriorates on this soil, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, cheatgrass and low-value plants are dominant. Because of stony and shallow soils, seedbed preparation and seeding of poor condition range are not practical.

Areas of this soil provide food and habitat for mule deer, especially in winter and early in spring when other areas are covered with snow. Areas also provide habitat for small animals and game birds.

This soil is severely limited for community and recreational uses because of slope, slow permeability, shrink-swell potential, and stoniness. Extensive design modifications are needed but in most cases are not practical for these uses.

This soil is in capability subclass VIIs.

44—Stanfield fine sandy loam. This moderately deep, moderately well drained soil is on low terraces along Willow Creek. It formed in alluvium from loess and volcanic ash. Average slope is 1 percent. Elevation is 300 to 450 feet. The average annual precipitation is 9 to 10 inches, and the average annual temperature is 52 to 53 degrees F. The frost-free period is 150 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The next layer is brown silt loam about 7 inches thick. The underlying material is brown very fine sandy loam about 4 inches thick over a brown, strongly cemented hardpan about 11 inches thick. Below the hardpan is brown silt loam to a depth of 60 inches or more. The profile is calcareous throughout.

Included with this soil in mapping are 15 percent Kimberly and Powder soils and Xeric Torrifluvents.

Permeability of the Stanfield soil is moderate above the hardpan and very slow through the hardpan. Effective rooting depth is limited by the hardpan, which is at a depth of 20 to 40 inches, and by the high salt content above the pan. Available water capacity is 3.5 to 7.5 inches. Water supplying capacity is 6 to 9 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

Most areas of this soil are used for irrigated crops. The main crops are annual wheat and alfalfa hay. Some areas are used for wildlife habitat and for range.

The main concerns in managing this soil for crops are the high content of sodium and soluble salt above the pan, the hardpan, the low available water capacity, and the hazard of soil blowing. Because of the high content of sodium and soluble salt, reclamation is necessary to successfully produce most crops. In reclaiming this soil, the hardpan is fractured to allow adequate underdrainage and free movement of water through the soil. A soil amendment that contains exchangeable calcium to replace the sodium is then added; gypsum is commonly used as an amendment, and the amount needed is determined by a soil test. The sodium and soluble salts are then leached by large amounts of irrigation water (*10*). Permeability of this soil is good, and the salts can be readily leached after the hardpan is fractured. In irrigated areas of this soil, water is applied by sprinklers. Center pivot systems are most commonly used. After reclamation, light, frequent applications of water are needed because of the low available water capacity. A suitable cropping system in irrigated areas is 1 to 3 years of wheat followed by 3 to 5 years of alfalfa. However, if wheat is grown consecutively for more than 1 year, controlling diseases and weeds can be a serious concern in management.

Winter cover crops; proper timing of irrigation, cultivation, and planting; minimum tillage; and double cropping help control soil blowing. Blowout areas can be treated by disking in straw mulch and seeding to adapted grasses. Soil blowing is critical when new land is broken out of rangeland for irrigated farming. Practices that are needed to overcome soil blowing at this time are complete development of the irrigation system before land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving the vegetation intact in areas that are not cropped.

Areas of this soil provide habitat for a variety of small animals and upland game birds, including ring-necked pheasant and valley quail. Mule deer use these areas sparingly. Areas near the Columbia River and the mouth of Willow Creek are used by a variety of migratory waterfowl.

The native plant community on this soil is dominated by giant wildrye. Some saltgrass is in the stand, and greasewood is common.

When range deteriorates on this soil, the proportion of giant wildrye decreases and the proportion of saltgrass and greasewood increases. If deterioration is severe, cheatgrass and greasewood become dominant and much ground is left bare. Where this soil has been flushed with water, however, it can be seeded to alkaline-tolerant grasses for dryland pasture. Also, marked changes occur in the plant community, and other grasses are suitable for seeding. After reclamation, this soil is well suited to irrigated pasture and hay.

This soil is limited for community uses because of depth to the hardpan. Design modifications are needed for the development of dwellings, small buildings, and sanitary facilities. This soil is limited for recreational uses because of the dusty surface.

This soil is in capability subclass IVs irrigated.

45B—Taunton loamy fine sand, 2 to 5 percent slopes. This moderately deep, somewhat excessively

drained soil is on terraces. It formed in old alluvium that has been reworked by wind. Average slope is 3 percent. Elevation is 700 to 1,000 feet. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 51 degrees F. The frost-free period is 140 to 170 days at 32 degrees and 170 to 200 days at 28 degrees.

Typically, the surface layer is dark brown loamy fine sand about 4 inches thick. The subsoil is brown fine sandy loam about 4 inches thick. The substratum is calcareous, brown fine sandy loam about 13 inches thick. It is underlain by a cemented, calcareous hardpan.

Included with this soil in mapping are 10 percent Sagehill and Warden soils and 5 percent Olex soils.

Permeability of the Taunton soil is moderately rapid above the pan and very slow within the pan. Available water capacity is 2.5 to 6 inches. Water supplying capacity is 4 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is high.

Most areas of this soil are used for range and wildlife habitat. Where water is available, this soil has potential for irrigated wheat, potatoes, corn, and alfalfa hay.

The native plant community on this soil is mainly needleandthread, bluebunch wheatgrass, and Indian ricegrass. Generally, needleandthread is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow are common. Big sagebrush commonly occurs in minor amounts.

When range deteriorates on this soil, forage bunchgrasses decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe as a result of fire or other disturbances, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding to dryland grasses are practical measures. In areas in which this soil is seeded to grass, soil blowing presents a special problem to management. Direct drill seeding following a fire is a good method to restore grasses in a reasonable length of time. Grasses selected for dryland seeding should have strong seeding vigor and be drought resistant. Crested wheatgrass and Siberian wheatgrass are suitable. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is limited for sanitary facilities because of the cemented hardpan and seepage. It is limited for other community developments, such as dwellings and commercial buildings, because of the cemented hardpan and low strength of the soil material. This soil is suitable for the construction of roads and streets. It is limited for most recreational facilities because of the dusty surface and slope. Design modifications are needed in places for most community and recreational uses, except for roads and streets.

This soil is in capability subclass VIe dryland.

46C—Tub gravelly clay loam, 1 to 12 percent slopes. This very deep, well drained soil is on uplands in the Lonerock area. It formed in loess and colluvium over waterlaid sediment. Average slope is 5 percent. Elevation is 2,800 to 3,600 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 45 to 48 degrees F. The frost-free period is 90 to 120 days at 32 degrees and 120 to 150 days at 28 degrees.

Typically, the surface layer is black gravelly clay loam about 7 inches thick. The subsoil is black and very dark grayish brown cobbly clay and silty clay loam about 30 inches thick. The substratum is calcareous, dark brown silty clay loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Simas and Gwinly soils and 5 percent Schrier and Ukiah soils.

Permeability of the Tub soil is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches. Water supplying capacity is 6 to 9 inches. Runoff is slow, and the hazard of erosion is slight to moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation. Grain-hay is the main crop, but some wheat and barley are grown. Some areas are used for dryland pasture, range, and wildlife habitat. A few areas are used for irrigated hay and pasture.

The main needs in managing this soil for grain crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation help minimize erosion and maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are needed in places on the steeper slopes to help prevent erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 20 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For pasture, suitable grasses and legumes grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall wheatgrass, and smooth brome.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Areas of this soil provide good habitat for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of the content of clay and slow permeability. It is limited for dwellings, small buildings, and roads and streets because of shrink-swell potential and low strength. It is limited for recreational facilities because of slow permeability. Design modifications are needed in places for all these uses.

This soil is in capability subclass IIIe dryland and capability subclass IVe irrigated.

46E—Tub stony silty clay loam, 12 to 40 percent slopes. This very deep, well drained soil is on north-facing exposures in the Lonerock area. It formed in loess and colluvium over waterlaid sediment. Average slope is 25 percent. Elevation is 2,800 to 3,600 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 45 to 48 degrees F. The frost-free period is 90 to 120 days at 32 degrees and 120 to 150 days at 28 degrees.

Typically, the surface layer is black stony silty clay loam about 7 inches thick. The subsoil is black and very dark grayish brown cobbly clay and silty clay loam about 30 inches thick. The substratum is calcareous, dark brown silty clay loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Simas and Gwinly soils and 5 percent Schrier and Ukiah soils.

Permeability of the Tub soil is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches. Water supplying capacity is 6 to 9 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Areas of this soil are used for range and wildlife habitat.

The main concern in managing this soil is the maintenance of plant cover to help control water erosion.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annual grasses and low-value forbs, such as common teasel and bull thistle, are dominant. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical measures. Intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil for food and cover in summer and late in fall because of the cooler temperatures and proximity to cover. Small animals and game birds also use the areas for food and cover.

This soil is severely limited for most community developments because of slope, slow permeability, and shrink-swell potential. It is limited for most recreational development because of slope. Extensive design modifications are needed for many of these uses.

This soil is in capability subclass VIe.

47C—Ukiah cobbly silty clay loam, 2 to 12 percent slopes. This moderately deep, well drained soil formed in colluvium from volcanic tuff near Lonerock and in Lost Valley. Average slope is 6 percent. Elevation is 3,000 to 3,900 feet. The average annual precipitation is 15 to 18 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free period is 100 to 110 days at 32 degrees and 100 to 140 days at 28 degrees.

Typically, the surface layer is very dark brown cobbly silty clay loam about 10 inches thick. The subsoil is dark brown cobbly clay about 10 inches thick. The upper part of the substratum is dark brown silty clay loam about 3 inches thick, and lower part of the substratum is strong brown gravelly loam about 5 inches thick. It is underlain by partially decomposed volcanic tuff.

Included with this soil in mapping are 10 percent Tub and 5 percent Waha soils.

Permeability of the Ukiah soil is very slow. Available water capacity is 3.5 to 6 inches. Water supplying capacity is 6 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow or medium, and the hazard of erosion is slight or moderate.

Areas of this soil are used for dryfarmed wheat, barley, hay, and pasture. Areas are also used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. Response of wheat and barley to nitrogen fertilizer is low. Generally 20 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For pasture, suitable grasses and legumes grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall fescue, and smooth brome.

The native plant community on this soil is mainly Idaho fescue. Sandberg bluegrass and bluebunch wheatgrass are prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue decreases and bluebunch wheatgrass and Sandberg bluegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annuals and other less desirable grasses and forbs are prominent. If range is in poor condition, seedbed preparation and seeding are practical measures. Intermediate wheatgrass, beardless wheatgrass, hard fescue, and alfalfa are suitable for dryland seeding.

Areas of this soil provide good habitat for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of the content of clay and depth to rock. It is limited for dwellings, small buildings, and roads and streets because of shrink-swell potential and low strength. This soil is limited for recreational facilities because of the content of clay and presence of stones. Design modifications are necessary in places for all of these uses.

This soil is in capability subclass IVe dryland.

47E—Ukiah cobbly silty clay loam, 12 to 35 percent slopes. This moderately deep, well drained soil is mainly on south-facing exposures near Lonerock and in Lost Valley. It formed in colluvium from volcanic tuff. Average slope is 20 percent. Elevation is 3,000 to 3,900 feet. The average annual precipitation is 15 to 18 inches, and the average annual temperature is 45 to 49 degrees F. The frost-free period is 100 to 110 days at 32 degrees and 100 to 140 days at 28 degrees.

Typically, the surface layer is very dark brown cobbly silty clay loam about 10 inches thick. The subsoil is dark brown cobbly clay about 10 inches thick. The upper part of the substratum is dark brown silty clay loam about 3 inches thick, and the lower part of the substratum is strong brown gravelly loam about 5 inches thick. It is underlain by partially decomposed volcanic tuff.

Included with this soil in mapping are 10 percent Tub and 5 percent Waha soils.

Permeability of the Ukiah soil is very slow. Available water capacity is 3.5 to 6 inches. Water supplying capacity is 6 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow occur throughout the stand in minor amounts. Shrubs are nearly absent.

When range deteriorates on this soil, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, cheatgrass and other low-value plants are dominant and the hazard of erosion is high. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes are practical. Beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa are suitable for dryland seeding.

Areas of this soil provide suitable habitat for mule deer, small animals, and game birds.

This soil is limited for sanitary facilities because of slope, content of clay, and depth to rock. It is limited for dwellings, small buildings, and roads and streets because of slope, shrink-swell potential, and low strength. This soil is limited for recreational facilities because of slope and large stones. Extensive design modifications are needed in places for all these uses.

This soil is in capability subclass VIe.

48B—Waha silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess. Average slope is 5 percent. Elevation is 3,000 to 4,300 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 46 to 49 degrees F. The frost-free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The upper part of the subsoil is dark brown silty clay loam about 14 inches thick, and the lower part of the subsoil is brown extremely cobbly silt loam about 6 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 5 percent Gwinly and Rockly soils.

Permeability of the Waha soil is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runofff is slow, and the hazard of erosion is slight.

Nearly all areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay are grown. Some areas are used for range, dryland pasture, and wildlife habitat.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, cross-slope tillage in the more nearly level areas and contour tillage and diversions in the steeper areas are desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, about 25 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, intermediate wheatgrass, and hard fescue. For dryland hay, suitable grasses grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall wheatgrass, and smooth brome.

The native plant community on this soil is mainly Idaho fescue. Sandberg bluegrass and bluebunch wheatgrass are prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue decreases and bluebunch wheatgrass and Sandberg bluegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annuals and other less desirable grasses and forbs are prominent. If range is in poor condition, seedbed preparation and seeding are practical meas-

ures. Intermediate wheatgrass, beardless wheatgrass, hard fescue, and alfalfa are suitable for dryland seeding.

Areas of this soil provide good habitat for mule deer, small animals, and game birds.

This soil is limited for community developments, for roads and streets, and for dwellings because of depth to bedrock. Design modifications are needed in places for most uses. This soil is limited for recreational uses because of dustiness.

This soil is in capability subclass IIIe.

49D—Waha silt loam, 7 to 25 percent north slopes. This moderately deep, well drained soil is on uplands. It formed in loess. Elevation is 3,000 to 4,300 feet. Average slope is 15 percent. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 46 to 49 degrees F. The frost-free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The upper part of the subsoil is dark brown silty clay loam about 14 inches thick, and the lower part of the subsoil is brown extremely cobbly silt loam about 6 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 5 percent Gwinly and Rockly soils and 2 percent Rock outcrop and ash pockets.

Permeability of the Waha soil is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About 60 percent of the acreage of this soil is dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions are needed to help prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of low annual precipitation. Generally, 20 pounds or less per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryland hay, suitable grasses grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall wheatgrass, and smooth brome.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annual grasses and low-value forbs, such as common teasel and bull thistle, are dominant. If range is in poor condition, seedbed preparation and seeding to grass are practical measures. Intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in summer and late in fall because of the cooler temperatures and proximity to cover. Areas of this soil also provide good habitat for small animals and game birds.

This soil is severely limited for all community and recreational uses because of slope and depth to bedrock. Design modifications are needed in places.

This soil is in capability subclass IVe.

49E—Waha silt loam, 25 to 40 percent north slopes. This deep, well drained soil is on uplands. It formed in loess. Average slope is 30 percent. Elevation is 3,000 to 4,300 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 46 to 49 degrees F. The frost-free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The upper part of the subsoil is dark brown silty clay loam about 14 inches thick, and the lower part of the subsoil is brown extremely cobbly silt loam about 6 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 10 percent Wrentham soils, Rock outcrop, and ash pockets.

Permeability of the Waha soil is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annual grasses and low-value forbs, such as common teasel and bull thistle, are dominant. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical. Intermedi-

ate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in summer and late in fall because of the cooler temperatures and proximity to cover. Areas of this soil also provide good habitat for small animals and game birds.

This soil is severely limited for all community and recreational uses because of slope and depth to bedrock. Extensive design modifications are needed.

This soil is in capability subclass VIe.

50D—Waha silt loam, 7 to 25 percent south slopes. This moderately deep, well drained soil is on uplands. It formed in loess. Average slope is 15 percent. Elevation is 3,000 to 4,300 feet. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 46 to 49 degrees F. The frost-free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The upper part of the subsoil is dark brown silty clay loam about 14 inches thick, and the lower part of the subsoil is brown extremely cobbly silt loam about 6 inches thick. It is underlain by fractured basalt.

Included with this soil in mapping are 10 percent Gwinly and Rockly soils.

Permeability of the Waha soil is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is commonly 20 to 24 inches but ranges to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for range and wildlife habitat. Some areas are dryfarmed in a grain-fallow rotation. Winter wheat is the main crop, but some barley is grown. A few areas are used for dryland hay and pasture.

The native plant community on this soil is mainly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow occur throughout the stand in minor amounts. Shrubs are nearly absent.

When range deteriorates on this soil, plant vigor is greatly reduced and bluebunch wheatgrass and other desirable grasses decrease. If deterioration is severe, cheatgrass and other low-value plants are dominant and the potential for erosion is high. Seedbed preparation and seeding are practical measures if range is in poor condition. Beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa are suitable for dryland seeding.

Areas of this soil are used by mule deer in winter and early in spring when other areas are snow covered. Wildlife habitat should be considered in management of this soil.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions are needed to help prevent severe erosion that results from rapid runoff during periods of high-intensity rainfall and snowmelt. The average depth of this soil is 20 to 24 inches, and because of this, crop production is lower than for other Waha soils. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation and shallow soil depth. Generally, 20 pounds or less per acre of nitrogen fertilizer is applied in spring or fall. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall fescue, and smooth brome.

Areas of this soil provide good habitat for mule deer, small animals, and game birds.

This soil is severely limited for all community and recreational uses because of slope and depth to bedrock. Extensive design modifications are needed in places.

This soil is in capability subclass IVe.

51D—Waha-Rockly complex, 2 to 20 percent slopes. These soils are on ridgetops (fig. 7). Elevation is 3,000 to 4,300 feet. Average slope is 10 percent. The average annual precipitation is 14 to 18 inches, and the average annual temperature is 46 to 49 degrees F. The average frost-free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

This complex is about 50 percent Waha soil and 35 percent Rockly soil. These soils are in patterns that are locally known as "biscuit-scabland." The Rockly soil is scabland between and around the areas of Waha soil. Where slope is less than 10 percent, the Waha soil is on circular mounds, or biscuits, that have a convex surface and are deeper in the center than on the edges. Where slope is more than 10 percent, the Waha soil is on elongated mounds in which the long axis is parallel to the slope. The circular mounds are 20 to 50 feet in diameter and 20 to 40 feet apart. The elongated mounds are 100 to 300 feet long and 30 to 60 feet wide.

Included with these soils in mapping are about 15 percent Gwinly soils.

Typically, the surface layer of the Waha soil is very dark brown silt loam about 12 inches thick. The upper part of the subsoil is dark brown silty clay loam about 14 inches thick, and the lower part of the subsoil is brown extremely cobbly silt loam about 6 inches thick. It is underlain by fractured basalt.

Permeability of the Waha soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Runoff is slow, and the hazard of erosion is slight.

Typically, the surface layer of the Rockly soil is dark brown very cobbly loam about 3 inches thick. The sub-

Figure 7.—Landscape of Waha-Rockly complex, 2 to 20 percent slopes. In foreground is Rockly very cobbly loam "scabland." In center are Waha silt loam "biscuits."

soil is dark brown extremely cobbly clay loam about 4 inches thick. It is underlain by fractured basalt.

Permeability of the Rockly soil is moderately slow. Effective rooting depth is 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is 1 to 4 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Nearly all areas of this complex are used for range and wildlife habitat.

The main concern in managing these soils is the maintenance of plant cover to help control water erosion.

The native plant community on the Waha soil is mainly Idaho fescue. Sandberg bluegrass and bluebunch wheatgrass are prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand. The native plant community on the Rockly soil is mainly very shallow rooted plants, such as Sandberg bluegrass and Oregon bluegrass. Small amounts of Idaho fescue and bluebunch wheatgrass are in places. Low-growing perennial forbs, such as pussytoes and phlox, are common.

When range deteriorates on the Waha soil, Idaho fescue decreases and bluebunch wheatgrass and Sandberg bluegrass increase. When range deteriorates on the Rockly soil, small bluegrass decreases and low-value forbs increase. If deterioration is severe, the forage bunchgrasses on the Waha soil and the entire plant community on the Rockly soil are nearly eliminated, annuals and other less desirable grasses and forbs are prominent on the deeper Waha soil, and a barren rock pavement is formed on the interspersed Rockly soil. Because of stoniness and very shallow depth of the Rockly soil, seedbed preparation and seeding of poor condition range generally are not practical on this complex.

Most areas of this complex provide food and limited cover for mule deer, small animals, game birds, and songbirds.

The Waha soil is limited for community and recreational uses because of depth to bedrock. Design modifications are needed for the development of dwellings, small buildings, sanitary facilities, and recreational areas. The Rockly soil is severely limited for community and recreation uses because of depth to bedrock and large stones.

Extensive design modifications are necessary but in most cases are not practicable for the development of dwellings, small buildings, and sanitary facilities.

This complex is in capability subclass VIIs.

52B—Walla Walla silt loam, 1 to 7 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and small amounts of volcanic ash. Elevation is 900 to 1,200 feet. Average slope is 4 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is brown and dark brown silt loam about 27 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are 5 percent soils that are similar to the Walla Walla soil but have bedrock at a depth of less than 60 inches.

Permeability of the Walla Walla soil is moderate. Available water capacity is 11.0 to 12.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 60 inches. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Winter wheat is the main crop. Some areas are used for range and wildlife habitat. Where water is available, this soil is well suited to irrigated wheat, potatoes, corn, and alfalfa hay.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth.

Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, cross-slope tillage is desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of low annual precipitation. Generally 35 to 40 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and again in fall when plants are green and succulent. Most areas of this soil also provide suitable habitat for small animals and game birds.

This soil is limited for recreational uses because of dustiness. This soil is generally suited to community uses.

This soil is in capability subclass IIc dryland.

52C—Walla Walla silt loam, 7 to 12 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and small amounts of volcanic ash. Elevation is 900 to 1,200 feet. Average slope is 9 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is brown and dark brown silt loam about 27 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 5 percent soils that are similar to the Walla Walla soil but have bedrock at a depth of less than 60 inches.

Permeability of the Walla Walla soil is moderate. Available water capacity is 11.0 to 12.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Winter wheat is the main crop. Some areas are used for range and wildlife habitat. Where water is available, this soil is well suited to irrigated wheat, potatoes, corn, and alfalfa hay.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In irrigated areas, proper rates of water application and cross-slope or contour tillage of row crops are desirable to minimize soil loss resulting from runoff.

Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize water erosion and help maintain soil moisture. In addition, contour tillage and diversions are needed in places. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 35 to 40 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe,

the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and again in fall when plants are green and succulent. Most areas of this soil also provide suitable habitat for small animals and game birds.

This soil is generally well suited to community uses. Because of slope in places, sanitary facilities, dwellings, buildings, and streets and roads require some modification in design. Dustiness limits this soil for recreational facilities.

This soil is in capability subclass IIIe.

53D—Walla Walla silt loam, 12 to 20 percent north slopes. This very deep, well drained soil is on uplands. It formed in loess and small amounts of volcanic ash. Elevation is 900 to 1,200 feet. Average slope is 16 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is brown and dark brown silt loam about 27 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 5 percent ash pockets and soils that are similar to the Walla Walla soil but have bedrock at a depth of less than 60 inches.

Permeability of the Walla Walla soil is moderate. Available water capacity is 11.0 to 12.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Winter wheat is the main crop. Some areas are used for range and wildlife habitat. Where water is available, this soil is well suited to irrigated wheat, potatoes, corn, and alfalfa hay.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. In irrigated areas, proper rates of water application and cross-slope or contour tillage of row crops are desirable to minimize soil loss resulting from runoff.

Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize water erosion and help maintain soil moisture. In addition, contour tillage and diversions are desirable. Response of wheat and barley to nitrogen fertilizer is low because of low annual precipitation. Generally, 35 to 40 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

The native plant community on this soil is dominantly about equal amounts of bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annual weeds, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and again in fall when plants are green and succulent. Most areas of this soil also provide suitable habitat for small animals and game birds.

This soil is severely limited for community and recreational facilities because of slope.

This soil is in capability subclass IIIe.

53E—Walla Walla silt loam, 20 to 35 percent north slopes. This very deep, well drained soil is on uplands. It formed in loess and small amounts of volcanic ash. Elevation is 900 to 1,200 feet. Average slope is 28 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is brown and dark brown silt loam about 27 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent Wrentham and Nansene soils and 2 percent ash pockets and Rock outcrop.

Permeability of the Walla Walla soil is moderate. Available water capacity is 11.0 to 12.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 60 inches. Runoff is rapid, and the hazard of erosion is severe.

Most areas of this soil are used for range and wildlife habitat. Some areas are used for crops in a grain-fallow rotation. Winter wheat is the main crop.

The native plant community on this soil is dominantly about equal proportions of bluebunch wheatgrass and Idaho fescue. In places on slopes that face strongly to the north, Idaho fescue is dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and perennial forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated and annual weeds, lupine, and low-value shrubs are dominant. If range is in poor condition, seedbed prepara-

tion and seeding of the more gentle slopes to grass are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth.

Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage is desirable.

Mule deer use areas of this soil in spring and in fall when plants are green and succulent. Most areas of this soil also provide suitable habitat for small animals and game birds.

This soil is severely limited for community development and recreational facilities because of slope.

This soil is in capability subclass IIIe.

54D—Walla Walla silt loam, 12 to 20 percent south slopes. This very deep, well drained soil is on uplands. It formed in loess and small amounts of volcanic ash. Elevation is 900 to 1,200 feet. Average slope is 16 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is brown and dark brown silt loam about 27 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent soils that are similar to the Walla Walla soil but have bedrock at a depth of less than 60 inches and 5 percent Lickskillet soils.

Permeability of the Walla Walla soil is moderate. Available water capacity is 11.0 to 12.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Winter wheat is the main crop. Some areas are used for range and wildlife habitat. Where water is available, this soil has high potential for irrigated wheat, potatoes, corn, and alfalfa.

The main needs in managing this soil for crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth.

Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize water erosion and help maintain soil moisture. In addition, contour tillage and diversions are desirable. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 30 to 35 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

The native plant community on this soil is mainly bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass and Idaho fescue decrease and Sandberg bluegrass and forbs increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and cheatgrass, low-value forbs, and shrubs are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa are suitable for dryland seeding.

Mule deer use areas of this soil in spring and in fall when plants are green and succulent. Most areas of this soil also provide suitable habitat for small animals and game birds.

This soil is severely limited for community development and recreational facilities because of slope.

This soil is in capability subclass IIIe.

54E—Walla Walla silt loam, 20 to 35 percent south slopes. This very deep, well drained soil is on uplands. It formed in loess and small amounts of volcanic ash. Elevation is 900 to 1,200 feet. Average slope is 28 percent. The average annual precipitation is 12 to 14 inches, and the average annual temperature is 51 to 54 degrees F. The frost-free period is 150 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is brown and dark brown silt loam about 27 inches thick. The substratum is brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are 10 percent soils that are similar to the Walla Walla soil but have bedrock at a depth of less than 60 inches and 5 percent Lickskillet soils and Rock outcrop.

Permeability of the Walla Walla soil is moderate. Available water capacity is 11.0 to 12.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 60 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. Some areas are used for crops in a grain-fallow rotation. Winter wheat is the main crop.

The native plant community on this soil is dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the forage bunchgrasses are nearly eliminated, much ground is left bare, and the hazard of erosion is high. If range is in poor condition, preparing a seedbed and seeding of the more gentle slopes to grass are practical

measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth.

Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize water erosion and help maintain soil moisture. In addition, contour tillage is desirable.

Mule deer use areas of this soil in spring and in fall when plants are green and succulent. Most areas of this soil also provide suitable habitat for small animals and game birds.

This soil is severely limited for community development and recreational facilities because of slope.

This soil is in capability subclass IVe.

55B—Warden silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and the underlying calcareous, lacustrine silt. Elevation is 500 to 1,200 feet. Average slope is 3 percent. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 50 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 3 inches thick. The subsoil is dark brown and brown silt loam about 18 inches thick. The upper part of the substratum is brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, grayish brown and dark grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are about 10 percent Ritzville and Sagehill soils and 5 percent Olex, Willis, and Taunton soils.

Permeability of the Warden soil is moderate. Available water capacity is 11.5 to 12.5 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for dryfarmed small grain. Where water is available, irrigated crops can be grown. Potential irrigated crops are potatoes, wheat, and alfalfa hay. Some areas are used for range and wildlife habitat.

The main need in managing this soil for crops is the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation help maintain soil moisture. In addition, contour tillage helps prevent erosion that results from rapid runoff during high-intensity rainfall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable grasses for waterways.

The native plant community on this soil is dominated by bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow are common. Big sagebrush occurs in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and big sagebrush increase. If deterioration is severe, big sagebrush dominates the stand and much ground is left bare under the brush. If fire is the major cause of deteriorated range, cheatgrass and rubber rabbitbrush are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Following a fire, direct drill seeding without seedbed preparation is a good way to restore grasses in a reasonable length of time. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is generally well suited to community uses. Because of the dusty surface, this soil has some limitations for recreational facilities. Also, levelling in places is required for playgrounds.

This soil is in capability subclass IVc dryland.

55C—Warden silt loam, 5 to 12 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and the underlying calcareous, lacustrine silt. Elevation is 500 to 1,200 feet. Average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 3 inches thick. The subsoil is dark brown and brown silt loam about 18 inches thick. The upper part of the substratum is brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, grayish brown and dark grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are about 10 percent Ritzville and Sagehill soils and 5 percent Olex, Willis, and Taunton soils.

Permeability of the Warden soil is moderate. Available water capacity is 11.5 to 12.5 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for dryfarmed small grain. Where water is available, irrigated crops can be grown. Potential irrigated crops are potatoes, annual wheat, and alfalfa hay. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of the soil from water erosion and the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent erosion that results from rapid runoff during high-intensity rainfall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable grasses for waterways.

The native plant community on this soil is dominated by bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow are common. Big sagebrush occurs in the stand.

When range deteriorates, bluebunch wheatgrass decreases and Sandberg bluegrass and big sagebrush increase. If deterioration is severe, big sagebrush is dominant and a large amount of ground is left bare under the brush. If fire is the major cause of range deterioration, cheatgrass and rubber rabbitbrush are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Following a fire, direct drill seeding without seedbed preparation is a good way to restore grasses. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass or beardless wheatgrass are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small mammals are common.

This soil is limited for community uses because of slope and for recreational uses because of slope and dustiness.

This soil is in capability subclass IVe dryland.

55D—Warden silt loam, 12 to 20 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and the underlying calcareous, lacustrine silt. Elevation is 500 to 1,200 feet. Average slope is 15 percent. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 3 inches thick. The subsoil is dark brown and brown silt loam about 18 inches thick. The upper part of the substratum is brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, grayish brown and dark grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are about 10 percent Ritzville and Sagehill soils and 5 percent Olex soils.

Permeability of the Warden soil is moderate. Available water capacity is 11.5 to 12.5 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage of this soil is used for dryfarmed small grain, and about half the acreage is used for range and wildlife habitat. Where water is available, the less sloping parts of this unit are suited to irrigated crops. Potential irrigated crops are potatoes, annual wheat, and alfalfa hay.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth.

In dryfarmed areas, stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage, and diversions help prevent erosion that results from rapid runoff during high-intensity rainfall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for waterways.

The native plant community on this soil is dominated by bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and big sagebrush increase. If deterioration is severe, big sagebrush is dominant and much ground is left bare under the brush. If fire is the major cause of deterioration, cheatgrass and rubber rabbitbrush are dominant. If range is in poor condition, seedbed preparation and seeding are practical measures. Following a fire, direct drill seeding without seedbed preparation is a good way to restore grasses. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass or beardless wheatgrass are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

This soil is limited for community and recreational uses because of slope.

This soil is in capability subclass IVe dryland.

55E—Warden silt loam, 20 to 40 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and the underlying calcareous, lacustrine silt. Elevation is 500 to 1,200 feet. Average slope is 30 percent. The average annual precipitation is 8 to 9 inches, and the average annual temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 3 inches thick. The subsoil is dark brown and brown silt loam about 18 inches thick. The upper part of the substratum is brown silt loam about 9 inches thick, and the lower part of the substratum is calcareous, grayish brown and dark grayish brown silt loam to a depth of 60 inches or more.

Included with this soil in mapping are about 10 percent Ritzville and Sagehill soils and 5 percent Olex soils.

Permeability of the Warden soil is moderate. Available water capacity is 11.5 to 12.5 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is rapid, and the hazard of erosion is high.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is dominated by bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow are common. Big sagebrush occurs in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and big sagebrush increase. If deterioration is severe, big sagebrush is dominant and much ground is left bare under the brush. If fire is the major cause of deterioration, cheatgrass and rubber rabbitbrush are dominant. If range is in poor condition, seedbed preparation and seeding on the more gentle slopes are practical measures. Following a fire, direct drill seeding without seedbed preparation is a good way to restore grasses Grasses selected for seeding should have strong seedling vigor and be drought resistant. Crested wheatgrass or beardless wheatgrass are suitable for seeding.

Grazing by livestock should be limited mainly to winter months.

Areas of this soil support a small number of mule deer. Birds and small animals are common.

This soil is severely limited for recreational and community uses, including sanitary facilities, dwellings, and buildings because of slope.

This soil is in capability subclass VIe.

56B—Willis silt loam, 2 to 5 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess. Elevation is 500 to 2,000 feet. Average slope is 3 percent. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 49 to 52 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 2 inches thick. The subsoil is dark brown silt loam about I7 inches thick. The substratum is brown silt loam about 7 inches thick. It is underlain by a calcareous hardpan.

Included with this soil in mapping are about 5 percent Mikkalo, Olex, and Blalock soils and 5 percent Ritzville and Warden soils.

Permeability of the Willis soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage is desirable, particularly where slopes are long. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for waterways. For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding (fig. 8).

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of depth to the cemented pan. Design modifications are needed for the development of dwellings, small buildings, and sanitary facilities. This soil is limited for recreational facilities because of the dusty surface.

This soil is in capability subclass IVe dryland.

56C—Willis silt loam, 5 to 12 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess. Average slope is 9 percent. Elevation is 500 to 2,000 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 49 to 52 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 2 inches thick. The subsoil is dark brown silt loam about 17 inches thick. The substratum is brown silt loam about 7 inches thick over a calcareous hardpan.

Included with this soil in mapping are about 5 percent Mikkalo, Olex, and Blalock soils and 5 percent Ritzville soils.

Permeability of the Willis soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40

Figure 8.—Seeded crested wheatgrass range on Willis silt loam, 2 to 5 percent slopes.

inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed in a grain-fallow rotation. Wheat is the main crop, but some barley and dryland hay and pasture are grown. Some areas are used for range and wildlife habitat.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage, minimum tillage, and grassed waterways in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, cross-slope tillage, contour tillage, and diversions are generally needed to help prevent erosion that results from rapid runoff during periods of high-intensity rainfall or snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. Pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass are suitable for seeding waterways. For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses because of slope and depth to the cemented pan. Modifications in design are needed for development of dwellings, small buildings, and sanitary facilities. This soil is limited for recreational facilities because of slope.

This soil is in capability subclass IVe dryland.

56D—Willis silt loam, 12 to 20 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess. Average slope is 15 percent. Elevation is 500 to 2,000 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 49 to 52 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 2 inches thick. The subsoil is dark brown silt loam about 17 inches thick. The substratum is brown silt loam about 7 inches thick. It is underlain by a calcareous hardpan.

Included with this soil in mapping are about 5 percent Mikkalo and Olex soils and 5 percent Ritzville soils.

Permeability of the Willis soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage of this soil is dryfarmed in a grain-fallow rotation, and about half is used for range and wildlife habitat. Wheat is the main crop, but some barley and dryland hay and pasture are grown.

The main needs in managing this soil for crops are the protection of soil from water erosion and the conservation of soil moisture for plant growth. Stubble mulch tillage and minimum tillage used in combination with a crop-fallow rotation minimize erosion and help maintain soil moisture. In addition, contour tillage and diversions help prevent severe erosion that results from rapid runoff during high-intensity rainfall and snowmelt. Response of wheat and barley to nitrogen fertilizer is low because of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall. For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa,

crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass.

The native plant community on this soil is mainly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow occur throughout the stand. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and forbs increase. If deterioration is severe, bluebunch wheatgrass is nearly eliminated, cheatgrass and other low-value plants are dominant, and a large amount of ground is left bare. If range is in poor condition, seedbed preparation and seeding are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is limited for community uses and most recreational uses because of slope and depth to the cemented pan. Extensive design modifications are needed for the development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass IVe dryland.

56E—Willis silt loam, 20 to 30 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess. Average slope is 25 percent. Elevation is 500 to 2,000 feet. The average annual precipitation is 9 to 11 inches, and the average annual temperature is 49 to 52 degrees F. The frost-free period is 160 to 190 days at 32 degrees and 180 to 210 days at 28 degrees.

Typically, the surface layer is dark brown silt loam about 2 inches thick. The subsoil is dark brown silt loam about 17 inches thick. The substratum is brown silt loam about 7 inches thick. It is underlain by a calcareous hardpan.

Included with this soil in mapping are about 5 percent Mikkalo, Lickskillet, and Olex soils and 5 percent Ritzville soils.

Permeability of the Willis soil is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

Areas of this soil are used for range and wildlife habitat.

The native plant community on this soil is mainly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on this soil, bluebunch wheatgrass decreases and Sandberg bluegrass and Thurber needlegrass increase. If deterioration is severe, the bluebunch wheatgrass is nearly eliminated, a large amount of ground is left bare, and the potential for erosion is high. If range is in poor condition, seedbed preparation and seeding of the more gentle slopes to grass are practical measures. Big bluegrass, crested wheatgrass, and beardless wheatgrass are suitable for dryland seeding.

Most areas of this soil provide food for mule deer, small animals, and game birds.

This soil is severely limited for community and recreational uses because of slope. Extensive design modifications are needed for development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This soil is in capability subclass VIe.

57F—Wrentham-Rock outcrop complex, 35 to 70 percent slopes. This complex is on north-facing exposures on uplands. Average slope is about 50 percent. Elevation is 900 to 3,600 feet. The average annual precipitation is 10 to 14 inches, and the average annual temperature is 45 to 52 degrees F. The frost-free period is 60 to 100 days at 32 degrees and 100 to 150 days at 28 degrees.

This complex is about 55 percent Wrentham soil and 20 percent Rock outcrop.

Included with this complex in mapping are 25 percent Nansene and Lickskillet soils and soils that are similar to Wrentham soils but have depth of more than 40 inches or less than 20 inches, or are calcareous below a depth of 15 to 30 inches.

Typically, the Wrentham soil has a surface layer of very dark brown silt loam about 18 inches thick. The subsoil is dark brown very gravelly silt loam about 15 inches thick. It is underlain by basalt.

Permeability of the Wrentham soil is moderately slow. Available water capacity is 2.5 to 7 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

Rock outcrop consists of exposed areas of basalt.

Areas of this complex are used for grazing by livestock and for wildlife habitat.

The native plant community on this complex is mainly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a wide variety of perennial forbs occur throughout the stand in minor amounts. Shrubs are minor in the stand.

When range deteriorates on the Wrentham soil, Idaho fescue and Cusick bluegrass decrease and bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor and annual grasses and low-value forbs are prominent. Because of steep slopes, seedbed preparation and seeding of poor condition range are not practical.

Mule deer use areas of this complex in summer and fall because of the cooler temperatures and proximity to cover.

This complex is severely limited for community and recreational uses because of depth to bedrock, stones, and slope. The extensive design modifications which are necessary are rarely practical for the development of dwellings, small buildings, sanitary facilities, and recreational facilities.

This complex is in capability subclass VIIs.

58—Xeric Torrifluvents, nearly level. These very deep, somewhat excessively drained soils are on bottom lands of streams. They formed in alluvium and windlaid materials. Average slope is 1 percent. Elevation is 300 to 800 feet. The average annual precipitation is about 8 to 9 inches, and the average annual temperature is about 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The upper part of the substratum is brown fine sandy loam and loamy fine sand about 35 inches thick. The lower part of the substratum is dark brown loamy fine sand and gravelly loamy sand to a depth of 80 inches or more.

Included with these soils in mapping are 5 percent Ritzville soils and Dune land and 10 percent Sagehill, Quincy, and Kimberly soils.

Permeability of Xeric Torrifluvents is rapid. Effective rooting depth is 60 inches or more. Available water capacity and water supplying capacity are variable. Runoff is slow, and the hazard of erosion is slight to high. The hazard of soil blowing is moderate or high. Flooding is rare.

Most areas of these soils are used for range and wildlife habitat. Some hay and winter wheat are grown.

The native plant community on these soils is needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread is generally dominant, and Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow are common. Big sagebrush commonly occurs in minor amounts.

When range deteriorates on these soils, forage bunchgrasses decrease and Sandberg bluegrass and low-value forbs increase. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand. If range is in poor condition, seedbed preparation and seeding to dryland grasses are practical measures. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Crested and Siberian wheatgrasses are suitable for seeding. Grazing by livestock should be limited mainly to winter months.

Areas of these soils provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. Also, mule deer and smaller animals use these areas for food and cover.

The main needs in managing these soils for crops are the conservation of soil moisture for plant growth and the stabilization of streambanks against cutting by water. In irrigated areas, proper timing and rates of applying water are important. Where water is available, irrigation is by sprinklers. Wheel-line or hand-line systems are most commonly used. A suitable cropping system in irrigated areas is 1 or 2 years of wheat followed by 3 to 5 years of alfalfa. If wheat is grown consecutively for more than 1 year, controlling disease can be a serious concern in management. Because of rapid permeability and the high rate of water consumption in these soils, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are readily leached from the rooting zone.

In dryfarmed areas, stubble mulch tillage and minimum tillage used with a crop-fallow rotation where wheat is grown minimize erosion and help conserve soil moisture. Streambanks can be stabilized by maintaining streamside vegetation, such as giant wildrye and riparian shrubs. This vegetation provides cover for wildlife and should be considered in wildlife management.

These soils are limited for most community uses because of flooding. They are limited for camp areas because of flooding and small stones. They are favorable for most other recreational uses.

These soils are in capability subclass VIe dryland and capability subclass IIIe irrigated.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can

be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

About 291,000 acres in Gilliam County are used for crops and pasture. Of this, about 283,000 acres are used for dryfarmed crops and about 8,000 acres are irrigated. In 1976, winter wheat, the major crop in the county, made up 95 percent or 3,625,000 bushels of the small grain harvested, and barley made up 5 percent or 190,000 bushels. In addition to small grain production, about 14,000 tons of alfalfa and alfalfa-grass hay were produced in 1976.

Potatoes and corn are grown in rotation with other crops in some areas in the northeastern part of the county east of Willow Creek. Several thousand acres in the northern end of the county west of Willow Creek is used for range but has potential for irrigated crops. The development of this land for irrigated crops depends upon the availability of water and the cost of delivering the water to the land.

Nonirrigated cropland—Winter wheat is the major dryfarmed crop. Because of the low precipitation, wheat is grown in a grain-fallow rotation (fig. 9). This system involves alternate years for wheat production. Wheat is grown 1 year, and the field is left bare of vegetation, or fallowed, the following year to allow moisture to build up for the next wheat crop. Land to be fallowed is generally tilled early in spring after the previous crop harvest. The stubble is left intact throughout the winter to help retain precipitation and reduce soil blowing and water erosion. Stubble is tilled in fall in some areas for weed control, but this has an adverse affect on stored soil moisture in years when precipitation is below normal in spring.

Figure 9.—An area of Rhea soils in a grain-fallow rotation. Diversion terraces are in background.

Winter wheat is generally seeded in October or November; however, wheat is seeded in spring in some years for weed control. Also, a field is reseeded in spring when soil moisture is insufficient for seed germination in fall or when the stand is lost from frostkill. Seeding rates for winter wheat are generally 45 to 60 pounds per acre.

Low precipitation limits response of winter wheat to nitrogen fertilizer. The time and rate of fertilizer application to get maximum benefits depend on adequate soil moisture, precipitation, and soil depth. In Gilliam County, precipitation is the main factor affecting wheat yield potentials.

Weeds are controlled through the use of selective herbicides and rod weeders on fallowed soils. Aerial spraying of insecticides is used for insect infestation.

Loss of soil by water erosion is a major problem on dryland soils. Erosion losses can be reduced by the use of proper residue management, stubble mulch tillage, chisel plowing perpendicular to the slope, grassed waterways, and diversions placed at proper intervals.

Barley is an alternative dryfarmed crop. Planting barley on south-facing slopes is commonly desirable. These slopes are drier and warmer than most other slopes, and under these conditions barley generally has higher production than winter wheat. Winter-hardy spring varieties are commonly seeded in fall. However, these varieties are not as hardy or vigorous as wheat. In many years fall plantings are lost by frostkill and require reseeding in spring. Barley is not as effective for erosion control as winter wheat because the straw breaks down more rapidly.

Dryfarmed alfalfa hay and pasture are grown in some areas. Reseeding marginal cropland to a permanent stand of alfalfa and grass is a practical measure. This crop protects the soil from erosion and can be used for livestock grazing. Because of the low precipitation, yields are low. Areas that receive less than 12 inches of precipitation have insufficient moisture for dryfarmed hay. Proper innoculation of alfalfa seed before planting is important. Areas of hay need reseeding every 8 to 15 years depending on the variety.

Irrigated cropland—Irrigated farming is relatively new in Gilliam County. Alfalfa hay, pasture, winter wheat, and potatoes are the major irrigated crops (figs. 10, 11). Where water is available, large areas of rangeland in the northern part of the county have potential for irrigation. Crops that have potential for irrigation are corn, asparagus, dry beans, green beans, mint, soybeans, and sugar beets.

The most extensive irrigated crop is alfalfa for hay and pasture. Alfalfa is grown along the major drainages dissecting the county and in an area east of Willow Creek. Wheel-line, hand-line, and center-pivot irrigation systems are used. Fields in permanent hay or pasture need reseeding every 4 to 6 years depending upon the variety of alfalfa. In a rotation, hay or pasture is generally grown 3 to 5 years before being turned under. Hay or pasture commonly follows wheat or potatoes, where grown, in the rotation. Seeding of alfalfa hay or pasture from August through September is generally preferable, especially on sandy textured soils that are vulnerable to blowing in spring. When hay or pasture follows winter wheat, it is desirable to harvest the wheat, remove the excess stubble, and seed the alfalfa directly into the stubble. Volunteer grain can be controlled selectively with herbicides. To obtain healthy stands and maximum yields, alfalfa should be properly innoculated prior to seeding. Rates of fertilizer application should be based on soil tests.

Figure 10.—Irrigated wheat on Ritzville silt loam, 2 to 7 percent slopes.

Figure 11.—Seeded crested wheatgrass range in foregound on Ritzville soils.

Suitable grasses and legumes that are grown alone or in combination for hay and pasture where irrigation water is not adequate are alfalfa, birdsfoot trefoil, white clover, intermediate wheatgrass, crested wheatgrass, big bluegrass, pubescent wheatgrass, tall fescue, and tall wheatgrass. Where water is adequate and drainage is not a problem, suitable legumes and grasses for planting are alfalfa, white clover, orchardgrass, tall fescue, meadow foxtail, smooth brome, tall oatgrass, and big bluegrass.

Winter wheat is irrigated in some areas. Wheat is planted in August, in September, or early in October at a seeding rate of 60 to 100 pounds per acre. In the areas where wheat follows potatoes in a rotation, the potato vines are left on the soil for erosion control. If wheat follows wheat, stubble is disked in and wheat is planted in the stubble mulch. Irrigated wheat responds well to nitrogen fertilizer, which is applied in soluble forms through the sprinklers at the rate of 200 to 300 pounds per acre. Wheat is harvested in July and August. When wheat follows wheat, weeds and diseases can be serious concerns in management.

At present, potatoes are grown only in a small area east of Willow Creek. Potatoes generally are planted in February and March at the rate of about 25 bushels per acre. If potatoes are grown more than 2 consecutive years, diseases can be a serious concern in management. To reduce soil blowing, it is desirable to avoid planting parallel to the prevailing wind direction. If potatoes follow wheat, stubble is turned under and the field is irrigated to bring up volunteer wheat for a cover crop. The cover crop is turned under when the soil is wet, 4 to 6 weeks before potato planting. Minimum tillage or no tillage is feasible in places to reduce soil blowing. Deep plowing and a firm seedbed, prepared 5 to 7 inches deep, are desirable.

Potatoes require high levels of nutrients. Adequate amounts of potash are essential for starch production. Potatoes respond well to high rates of nitrogen applied in bands at planting time and as soluble forms as needed throughout the growing season. Addition of phosphorus is required in places. It is important to keep irrigated potatoes supplied with uniform soil moisture to produce well formed marketable tubers. Potato vines are killed by chemical or mechanical means about 10 to 14 days before the tubers are machine harvested to allow the skins to toughen and reduce bruising while harvesting. Weeds throughout the growing cycle are controlled by pre-emergence tillage, which is generally followed by deep cultivation as soon as the plants are visible. The deep cultivation is close to the rows, and it loosens the soil for tuber development. Selective herbicides are also utilized.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 8. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 8.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 8 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops (*11*). The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major

and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability subclass is identified in the description of each soil mapping unit in the section "Soil maps for detailed planning."

Range

Range occupies approximately 470,000 acres or about 60 percent of Gilliam County.

Range in Gilliam County is true grassland in which the broadleaved herbs and shrubs are insignificant as forage plants. Bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass make up nearly 90 percent of the potential native vegetation.

Natural plant communities that represent the grazing potential of the survey area are common. This is because many areas are deferred every other year in the wheat summer fallow cropping system. Productivity of the range can be maintained, or in many areas improved, by using management practices that are effective for specific kinds of soil and plant communities.

On most livestock ranches, the forage produced on rangeland is supplemented by wheat stubble and crop aftermath. In the northern fourth of the county near the Columbia River, winter is the best season of use. In this area, precipitation falls mostly as rain, and temperatures are relatively mild. Also, because of the frequent, strong westerly winds, soil blowing can be severe in spring, and protecting the area from grazing during the growing season is important.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 9 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the

area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 10 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 10, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4)

evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 11 shows, for each kind of soil, the degree and kind of limitations for building site development; table 12, for sanitary facilities; and table 14, for water management. Table 13 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 11. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 11 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 11 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 12 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 12 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to

be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 13 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 17 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 13 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in tables 17 and 18.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 14 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength,

and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 15 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 15 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 12, and interpretations for dwellings without basements and for local roads and streets, given in table 11.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 16, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are buckwheat, milkvetch, wheatgrass, and balsamroot.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are mountain-mahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include valley quail, mountain quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and coyote.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include mule deer, chukar and Hungarian partridge, meadowlark, valley quail, hawks, golden eagles, and owls.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the

profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 17 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 17 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 17 in the standard terms used by the U.S. Department of Agriculture (*9*). These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, for soils tested in the survey area, without group index numbers, is given in table 17. Also in table 17 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In this survey, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 18 shows estimated values for several soil characteristics and features that affect behavior of soils in

engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Clay is a mineral soil particle that is less than 0.002 millimeter in diameter. In table 18, the estimated clay content of each major soil horizon is given as a percent, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to absorb cations and to retain moisture. They influence the shrink-swell potential, permeability, and plasticity; the ease of soil dispersion; and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (oven dry) per unit volume. Volume is measured when the soil is at the field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C.

In table 18, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter for soil material that is less than 2 millimeters in diameter. The bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by the texture, kind of clay, content of organic matter, and structure of the soil.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are

moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

The only distinctions made in wind erodibility groups in this survey are groups 1, 2, 3, and 5. For management purposes, groups 1 and 2 are combined.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter of the plow layer is expressed as a percent, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth of the soil. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 19 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding; and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Cemented pans are hard subsurface layers, within a depth of 5 or 6 feet, that are strongly compacted (indurated). Such pans cause difficulty in excavation. The hardness of pans is similar to that of bedrock. A rippable pan can be excavated, but a hard pan generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter

are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*12*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 20, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haploxeroll (*Hapl*, meaning simple horizons, plus *xeroll*, the suborder of Mollisols that have a Xeric moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Calcic* identifies the subgroup. An example is Calcic Haploxeroll.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-silty, mixed, mesic, Calcic Haploxeroll.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition. An example is the Valby series.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*9*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or mapping units, of each soil series are described in the section "Soil maps for detailed planning."

Bakeoven series

The Bakeoven series consists of very shallow, well drained soils. These soils formed in loess and basalt colluvium. The average annual precipitation is about 12 inches. The average annual air temperature is about 48 degrees F.

Typical pedon of Bakeoven very cobbly loam, 2 to 20 percent slopes, NW1/4SE1/4SE1/4 sec. 10, T. 4 S., R. 20 E.

A1—0 to 4 inches; dark brown (7.5YR 3/2) very cobbly loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 35 percent cobbles, 20 percent pebbles; neutral (pH 6.6); clear wavy boundary.

B1—4 to 6 inches; dark brown (7.5YR 3/2) very cobbly loam, brown (7.5YR 5/3) dry; weak fine granular structure and weak thin platy; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 30 percent cobbles, 25 percent pebbles; neutral (pH 6.6); abrupt smooth boundary.

B2—6 to 10 inches; dark brown (7.5YR 3/3) very cobbly clay loam, brown (7.5YR 4/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; 45 percent cobbles, 20 percent pebbles; few thin patchy clay films on basalt rock fragments; neutral (pH 6.8); abrupt wavy boundary.

IIR—10 inches; basalt.

The solum is 35 to 75 percent coarse fragments. Depth to bedrock is 5 to 12 inches.

The A horizon has hue of 7.5YR or 10YR and chroma of 2 or 3 when moist or dry.

The B horizon has hue of 7.5YR or 10YR. The upper part of the B horizon has chroma of 2 or 3 when moist or dry, and the lower part has chroma of 3 or 4.

Blalock series

The Blalock series consists of shallow, well drained soils. These soils formed in mixed alluvium reworked by wind. The average annual precipitation is about 10 inches. The average annual air temperature is about 53 degrees F.

Typical pedon of Blalock loam, 0 to 7 percent slopes, 300 feet south of Rhea Creek Road, SE1/4NE1/4NE1/4 sec. 28, T. 3 N., R. 22 E.

A11—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate thin platy structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many very fine tubular pores; neutral (pH 7.0); abrupt smooth boundary.

A12—2 to 7 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral (pH 7.2); clear smooth boundary.

B21—7 to 12 inches; brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; mildly alkaline (pH 7.4); clear smooth boundary.

B22—12 to 18 inches; brown (10YR 4/3) gravelly loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine roots; many very fine tubular pores; 25 percent pebbles and indurated pan fragments; mildly alkaline (pH 7.6); abrupt wavy boundary.

IIC1casim—18 to 22 inches; light brownish gray (10YR 6/2) very gravelly duripan, white (10YR 8/1) dry; massive; indurated silica laminar capping, strongly cemented and indurated; extremely firm, extremely hard; 50 percent pebbles, 5 percent cobbles; very strongly calcareous.

IIC2ca—22 to 41 inches; brown (10YR 5/3) gravelly loam, pale brown (10YR 6/3) dry; massive; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent pebbles; strongly calcareous; strongly alkaline (pH 8.6); abrupt wavy boundary.

IICr—41 inches; weathered shale.

Depth to the duripan ranges from 10 to 20 inches. Depth to weathered bedrock is more than 40 inches.

The A horizon has chroma of 2 or 3 when moist or dry.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when moist or dry. It is loam or gravelly loam.

Condon series

The Condon series consists of moderately deep, well drained soils. These soils formed in loess mixed with small amounts of volcanic ash. The average annual precipitation is about 12 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Condon silt loam in an area of Condon and Valby silt loams, 1 to 7 percent slopes, 0.8 mile west of Condon city limits; 175 feet west of fence, 150 feet north of Oregon Highway 206, SE1/4SW1/4NW1/4 sec. 9, T. 4 S., R. 21 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak medium platy structure and weak medium granular; slightly hard, friable, slightly sticky and slightly plastic; many very

fine roots; common fine irregular pores; neutral (pH 7.0); abrupt smooth boundary.

B21—7 to 14 inches; very dark grayish brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) dry; weak medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

B22—14 to 20 inches; dark brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; neutral (pH 7.2); clear wavy boundary.

B3—20 to 31 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; neutral (pH 7.2); abrupt wavy boundary.

IIR—31 inches; basalt.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist.

The B horizon is silt loam that is 18 to 24 percent clay and has less than 15 percent sand that is coarser than very fine sand. Typically, it has value of 3 or 4 when moist and 5 or 6 when dry, but it has value of 3 when moist and 5 when dry above a depth of 10 inches. The B horizon has chroma of 2 or 3 when moist or dry.

Gwinly series

The Gwinly series consists of shallow, well drained soils. These soils formed in weathered basalt colluvium. The average annual precipitation is about 16 inches. The average annual air temperature is about 47 degrees F.

Typical pedon of Gwinly very cobbly silt loam, 7 to 40 percent slopes, SE1/4SW1/4SW1/4 sec. 7, T. 5 S., R. 24 E.

A11—0 to 2 inches; very dark grayish brown (10YR 3/2) very cobbly silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 30 percent pebbles, 20 percent cobbles; neutral (pH 6.6); clear smooth boundary.

A12—2 to 6 inches; very dark grayish brown (10YR 3/2) very cobbly silt loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 30 percent pebbles, 30 percent cobbles; neutral (pH 6.8); abrupt smooth boundary.

B1—6 to 10 inches; very dark grayish brown (10YR 3/2) very cobbly silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine roots; 30 percent pebbles, 30 percent cobbles; neutral (pH 7.0); clear smooth boundary.

B2t—10 to 14 inches; dark yellowish brown (10YR 3/4) extremely cobbly clay, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; 20 percent pebbles, 50 percent cobbles; neutral (pH 7.0); abrupt smooth boundary.

IIR—14 inches; basalt.

The depth to bedrock is 10 to 20 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 or 2 when moist and 2 or 3 when dry.

The B2t horizon is 40 to 50 percent clay. It has 40 to 80 percent rock fragments, mainly cobbles.

Hermiston series

The Hermiston series consists of very deep, well drained soils. These soils formed in alluvium derived from loess and ash. The average annual precipitation is about 12 inches. The average annual air temperature is about 50 degrees F.

Typical pedon of Hermiston silt loam in SW1/4NW1/4SE1/4 sec. 30, T. 1 S., R. 22 E.

A11—0 to 5 inches; very dark brown (10YR 2/2) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; mildly alkaline (pH 7.4); clear smooth boundary.

A12—5 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic, many fine roots; mildly alkaline (pH 7.6); abrupt wavy boundary.

A13—13 to 18 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; mildly alkaline (pH 7.6); abrupt wavy boundary.

A14—18 to 31 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary.

C1ca—31 to 42 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots;

strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary.
C2—42 to 60 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; strongly calcareous; moderately alkaline (pH 8.0).

The depth to bedrock is more than 60 inches. The thickness of the mollic epipedon is 20 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The C horizon has value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry.

Kahler series

The Kahler series consists of deep, well drained soils. These soils formed in volcanic ash, loess, and basalt colluvium. The average annual precipitation is about 19 inches. The average annual air temperature is about 44 degrees F.

Typical pedon of Kahler silt loam, bedrock substratum, 35 to 70 percent slopes, in NE1/4NE1/4SE1/4 sec. 1, T. 6 S., R. 22 E.

O1—1/2 inch to 0; fir and pine needles.
A11—0 to 2 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; neutral (pH 6.6); clear smooth boundary.
A12—2 to 23 inches; dark brown (7.5YR 3/2) silt loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; 5 percent pebbles; neutral (pH 6.6); gradual wavy boundary.
B2—23 to 35 inches; dark brown (7.5YR 3/3) cobbly silt loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; 10 percent pebbles, 10 percent cobbles; neutral (pH 6.6); gradual wavy boundary.
C—35 to 50 inches; dark brown (7.5YR 3/3) cobbly loam, brown (10YR 4/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common roots; 15 percent pebbles, 15 percent cobbles; neutral (pH 6.6); abrupt wavy boundary.
R—50 inches; basalt.

The depth to bedrock ranges from 40 to 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 2 or 3 when moist or dry.

The C horizon is loam or silt loam and has 10 to 30 percent pebbles and 10 to 30 percent cobbles.

Kimberly series

The Kimberly series consists of very deep, well drained soils. These soils formed in mixed alluvium. The average annual precipitation is about 10 inches. The average annual air temperature is about 52 degrees F.

Typical pedon of Kimberly fine sandy loam, 0 to 3 percent slopes, near Willow Creek, NE1/4SE1/4NE1/4 sec. 1, T. 2 N., R. 22 E.

Ap—0 to 8 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; many very fine pores; 5 percent pebbles; mildly alkaline (pH 7.4); abrupt smooth boundary.
AC1—8 to 13 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; many very fine pores; 5 percent pebbles; mildly alkaline (pH 7.6); clear wavy boundary.
AC2—13 to 21 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; many very fine pores; 5 percent pebbles; weakly calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.
C1—21 to 50 inches; dark brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many very fine pores; 2 percent pebbles; weakly calcareous; moderately alkaline (pH 8.0); abrupt wavy boundary.
C2—50 to 60 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 5/3) dry; massive; slightly hard, very friable, nonsticky and nonplastic; 2 percent pebbles; moderately calcareous; moderately alkaline (pH 8.0).

The depth to bedrock is more than 60 inches. The depth to secondary lime is 10 to 30 inches. The thickness of the mollic epipedon is 10 to 20 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The AC horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The C horizon has value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. The C horizon is sandy loam or fine sandy loam.

Krebs series

The Krebs series consists of deep, well drained soils. These soils formed in loess and in the underlying water-laid sediment. The average annual precipitation is about

9 inches. The average annual air temperature is about 53 degrees F.

Typical pedon of Krebs silt loam, 5 to 12 percent slopes, 20 feet north of Rhea Road, SW1/4NE1/4SW1/4 sec. 20, T. 3 N., R. 22 E.

A11—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral (pH 7.0); gradual wavy boundary.

A12—5 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak medium granular structure and weak medium subangular blocky; slightly hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; neutral (pH 7.2); gradual wavy boundary.

B1—10 to 17 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; neutral (pH 7.2); gradual wavy boundary.

B2t—17 to 27 inches; brown (10YR 5/3) silty clay, pale brown (10YR 6/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few roots; many very fine tubular pores; thin continuous clay films on ped faces and in pores; mildly alkaline (pH 7.6); gradual wavy boundary.

B3ca—27 to 36 inches; pale brown (10YR 6/3) silty clay loam, very pale brown (10YR 8/3) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few roots; common very fine tubular pores; moderately calcareous with thin seams of lime; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cca—36 to 48 inches; pale brown (10YR 6/3) silty clay loam, white (10YR 8/1) dry; massive; very hard, firm, sticky and plastic; few roots; few very fine irregular pores; strongly calcareous; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cr—48 to 63 inches; pale brown (10YR 6/3), white (10YR 8/1) dry; partially decomposed diatomite.

The depth to the paralithic contact is 40 to 60 inches. The thickness of the mollic epipedon is 7 to 20 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist or dry.

The B2t horizon has value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4 when moist or dry. It is silty clay or clay.

Lickskillet series

The Lickskillet series consists of shallow, well drained soils. These soils formed in shallow, stony colluvium consisting of a mixture of loess, coarse fragments, and residuum weathered from the underlying basalt. The average annual precipitation is about 12 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Lickskillet very stony loam, 7 to 40 percent slopes, 100 feet north of gravelled road, SW1/4SW1/4SW1/4 sec. 20, T. 4 S., R. 21 E.

A1—0 to 3 inches; dark brown (10YR 3/3) very stony loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 25 percent pebbles, 10 percent cobbles and stones; neutral (pH 6.8); clear smooth boundary.

B1—3 to 11 inches; dark brown (10YR 3/3) very gravelly loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 30 percent pebbles, 10 percent cobbles and stones; neutral (pH 6.8); abrupt wavy boundary.

B2—11 to 15 inches; dark brown (7.5YR 3/3) very gravelly clay loam, brown (7.5YR 5/3) dry; moderate very fine subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; 40 percent pebbles, 10 percent cobbles and stones; neutral (pH 6.8); clear, wavy boundary.

11R—15 inches; fractured basalt.

The depth to bedrock is 12 to 20 inches. The thickness of the mollic epipedon is 10 to 19 inches. Hue of the solum is 10YR or 7.5YR.

The A horizon has value of 2 or 3 when moist and chroma of 2 or 3 when moist or dry.

The B2 horizon typically has value of 2 or 3 when moist, except in the lower part of some deeper pedons where value is 2 to 4 and chroma is 3 or 4 when moist or dry. The B2 horizon is heavy loam or clay loam and has 35 to 60 percent rock fragments.

Mikkalo series

The Mikkalo series consists of moderately deep, well drained soils. These soils formed in loess. The average annual precipitation is about 10 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Mikkalo silt loam, 7 to 12 percent slopes, 20 feet north of a graveled road, SE1/4SE1/4NE1/4 sec. 19, T. 1 S., R. 21 E.

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure and weak fine platy; slightly hard, friable, slightly sticky and slightly plastic; many very

fine roots; many very fine irregular pores; neutral (pH 6.8); clear wavy boundary.

A12—3 to 11 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 6.8); gradual wavy boundary.

B21—11 to 16 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak to moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; mildly alkaline (pH 7.4); gradual wavy boundary.

B22—16 to 27 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; mildly alkaline (pH 7.6); gradual smooth boundary.

B3ca—27 to 35 inches; dark brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 5 percent pebbles 2 to 10 millimeters in diameter; moderately calcareous; few streaks and splotches of soft powdery lime; mildly alkaline (pH 7.8); abrupt wavy boundary.

Cca—35 to 38 inches; brown (10YR 5/3) silt loam, white (10YR 8/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 15 percent pebbles 2 to 10 millimeters in diameter; strongly calcareous; moderately alkaline (pH 8.4); gradual wavy boundary.

IIR—38 inches; lime coated basalt.

The depth to bedrock is 20 to 40 inches. The thickness of the mollic epipedon is 7 to 15 inches. The control section is silt loam that has 8 to 12 percent clay and less than 15 percent material that is coarser than very fine sand.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist or dry.

The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when moist or dry. The B3ca horizon has value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or 3 when moist or dry.

The Cca horizon has value of 7 or 8 when dry and 4 to 6 when moist, and chroma of 2 or 3 when moist or dry. It is moderately calcareous to strongly calcareous.

Morrow series

The Morrow series consists of moderately deep, well drained soils. These soils formed in loess. The average annual precipitation is about 13 inches. The average annual air temperature is about 48 degrees F.

Typical pedon of Morrow silt loam, 7 to 12 percent slopes, SE1/4SW1/4NE1/4 sec. 6, T. 5 S., R. 23 E.

A11—0 to 3 inches; very dark brown (10YR 2/2) silt loam; brown (10YR 5/3) dry; weak fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral (pH 6.8); clear smooth boundary.

A12—3 to 9 inches; very dark brown (10YR 2/2) silt loam; brown (10YR 5/3 dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots, many very fine tubular pores; neutral (pH 6.8); abrupt smooth boundary.

IIB2t—9 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam; brown (10YR 5/3) dry; moderate medium and fine subangular and angular blocky structure; very hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; common moderately thick clay films in top 2 inches of horizon; neutral (pH 7.2); clear wavy boundary.

IIB3tca—13 to 20 inches; brown (10YR 4/3) light silty clay loam; pale brown (10YR 6/3) dry; moderate medium and fine angular and subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; common thin and moderately thick clay films; strongly calcareous; mildly alkaline (pH 7.6); clear wavy boundary.

IIC1ca—20 to 30 inches; brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; moderately calcareous; common light gray lime seams; moderately alkaline (pH 8.0); gradual boundary.

IIC2ca—30 to 38 inches; brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 5 percent pebbles, 5 percent cobbles; strongly calcareous; common light gray lime seams; moderately alkaline (pH 8.0); abrupt wavy boundary.

IIIR—38 inches; fractured basalt.

The depth to bedrock is 20 to 40 inches. The thickness of the mollic epipedon is 10 to 20 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist.

The B2t horizon is silty clay loam and has 27 to 35 percent clay. This horizon has value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist or dry. The B3ca horizon has value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3 when moist or dry.

The Cca horizon has value of 6 or 7 when dry, and chroma of 2 or 3 when moist or dry.

Nansene series

The Nansene series consists of very deep, well drained soils. These soils formed in loess. These soils have north-facing exposures. The average annual precipitation is about 12 inches. The average annual air temperature is about 50 degrees F.

Typical pedon of Nansene silt loam, 35 to 70 percent slopes, 30 feet south of gravelled road, SW1/4SE1/4SW1/4 sec. 16, T. 1 S., R. 20 E.

A11—0 to 3 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral (pH 6.6); abrupt wavy boundary.

A12—3 to 12 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral (pH 6.6); clear smooth boundary.

A13—12 to 21 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; weak coarse prismatic structure; slightly hard, very friable slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 6.8); clear smooth boundary.

B2—21 to 34 inches; dark brown (7.5YR 3/3) silt loam, brown (7.5YR 5/3) dry; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

B3—34 to 45 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; mildly alkaline (pH 7.4); abrupt smooth boundary.

C—45 to 60 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; many very fine tubular pores; mildly alkaline (pH 7.6).

The control section contains 0 to 5 percent basalt pebbles 1 inch or less in diameter. Pebbles and cobbles cover 0 to 5 percent of the surface. The depth to bedrock is more than 60 inches. The thickness of the mollic epipedon is 30 to 50 inches. In some pedons the soil is calcareous below a depth of 43 inches.

The B2 horizon has value of 4 or 5 when dry and 2 or 3 when moist. It has weak, coarse or medium prismatic structure.

The C horizon has value of 4 to 7 when dry and 3 to 5 when moist.

Olex series

The Olex series consists of very deep, well drained soils. These soils formed in loess and very gravelly alluvial materials. The average annual precipitation is about 10 inches. The average annual temperature is about 53 degrees F.

Typical pedon of Olex silt loam, 0 to 5 percent slopes, 50 feet south of unimproved farm road, SE1/4SW1/4NE1/4 sec. 33, T. 2 N., R. 20 E.

A11—0 to 1 inch; dark brown (10YR 3/3) silt loam; brown (10YR 5/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; neutral (ph 7.0); clear smooth boundary.

A12—1 to 12 inches; dark brown (10YR 3/3) silt loam; brown (10YR 5/3) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; 2 percent pebbles; neutral (ph 7.0); clear smooth boundary.

B2—12 to 24 inches; dark brown (10YR 3/3) gravelly silt loam; brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; 15 percent pebbles; neutral (pH 7.2); clear wavy boundary.

IIC1—24 to 32 inches; dark brown (10YR 3/3) very gravelly silt loam; brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; 60 percent pebbles; mildly alkaline (pH 7.4); clear wavy boundary.

IIC2ca—32 to 60 inches; brown (10YR 4/3) extremely gravelly silt loam; pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; 75 percent pebbles; pebbles lime coated on underside; soft powdery lime in matrix; moderately alkaline (pH 8.0).

The depth to very gravelly material ranges from 12 to 25 inches. The depth to bedrock is more than 60 inches.

The A horizon has chroma of 2 or 3 when moist or dry. It is silt loam and has 0 to 25 percent pebbles.

The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when moist or dry. It is silt loam and has 15 to 35 percent pebbles and 0 to 5 percent cobbles.

The IIC horizon has value of 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It is silt loam or loam and has 50 to 75 percent pebbles and 0 to 10 percent cobbles.

Powder series

The Powder series consists of very deep, well drained soils formed in alluvium from volcanic ash and weathered rock. The average annual precipitation is about 10 inches. The average annual temperature is about 49 degrees F.

Typical pedon of Powder silt loam, SW1/4 NW1/4NW1/4 sec. 23, T. I N., R. 21 E.

A11—0 to 3 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium and thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many medium and fine roots; neutral (pH 6.8); abrupt wavy boundary.

A12—3 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many medium and fine roots; neutral (pH 6.8); clear wavy boundary.

B21—13 to 20 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many medium and fine roots; neutral (pH 7.0); clear wavy boundary.

B22—20 to 26 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; slightly hard, friable; slightly sticky and slightly plastic; common medium and fine roots; slightly calcareous; mildly alkaline (pH 7.8); abrupt wavy boundary.

C1—26 to 41 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and fine roots; moderately calcareous; mildly alkaline (pH 7.8); abrupt wavy boundary.

C2—41 to 52 inches; very dark grayish brown (10YR3/2) silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common roots; neutral (pH 7.2); clear smooth boundary.

C3—52 to 61 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure; slightly hard, firm, slightly sticky and slightly plastic; common roots; neutral (pH 6.8).

The 10- to 40-inch control section is dominantly silt loam and has 10 to 17 percent clay. The thickness of the mollic epipedon is 20 to 32 inches.

The A horizon has chroma of 2 or 3 when moist or dry

The B horizon has chroma of 2 or 3 when moist or dry.

The C horizon is very fine sandy loam or silt loam. To a depth of 40 inches, it has value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. Below a depth of 40 inches, this horizon has chroma of 1 to 3 when moist or dry.

Prosser series

The Prosser series consists of moderately deep, well drained soils. These soils formed in loess. The average annual precipitation is about 8 inches. The average annual air temperature is about 53 degrees F.

Typical pedon of Prosser silt loam in an area of Prosser-Rock outcrop complex, 1 to 5 percent slopes, NE1/4NW1/4SE1/4 sec. 25, T. 4 N., R. 22 E.

A1—0 to 3 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; many very fine roots; neutral (pH 7.0); abrupt smooth boundary.

B2—3 to 19 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak medium prismatic structure; slightly hard, friable, nonsticky and slightly plastic; common very fine roots; mildly alkaline (pH 7.4); gradual wavy boundary.

C—19 to 25 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; massive, slightly hard, friable, nonsticky and slightly plastic; common very fine roots; 10 percent lime-coated pebbles; mildly alkaline (pH 7.4); abrupt smooth boundary.

IIR—25 inches; basalt.

The depth to bedrock ranges from 20 to 40 inches. The solum is silt loam or very fine sandy loam.

Quincy series

The Quincy series consists of very deep, excessively drained soils. These soils formed in mixed sands. The average annual precipitation is about 8 inches. The average annual air temperature is about 53 degrees F.

Typical pedon of Quincy loamy fine sand, 0 to 5 percent slopes, NE1/4NW1/4NW1/4 sec. 25, T. 3 N., R. 22 E.

C1—0 to 14 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; many very fine roots; neutral (pH 7.0); clear wavy boundary.

C2—14 to 50 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; 3 percent duripan fragments 2 to 10 millimeters in diameter; mildly alkaline (pH 7.5); clear wavy boundary.

C3—50 to 62 inches; very dark grayish brown (10YR 3/2) loamy fine sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; 3 percent duripan fragments 2 to 10 millimeters in diameter; slight effervescence; mildly alkaline (pH 7.8).

The 10- to 40-inch control section is sand to loamy fine sand. Less than 75 percent of the sand is very coarse, coarse, and medium. The clay content is less than 5 percent. Some pedons have unconforming material, including bedrock, at a depth of more that 50 inches. The matrix below a depth of 20 inches is slightly calcareous in some pedons. The soil has value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 or 3 when moist or dry.

Rhea series

The Rhea series consists of very deep, well drained soils. These soils formed in loess mixed with small amounts of volcanic ash. The average annual precipitation is about 12 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Rhea silt loam, 1 to 7 percent slopes, 15 feet east of U.S. Geological Survey bench mark No. B381, NW1/4SE1/4SW1/4 sec. 7, T. 4 S., R. 22 E.

A11—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; neutral (pH 6.6); abrupt smooth boundary.

A12—4 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; neutral (pH 6.8); clear smooth boundary.

B1—10 to 17 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

B21—17 to 25 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

B22—25 to 34 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; neutral (pH 7.2); clear smooth boundary.

C1ca—34 to 43 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; few streaks of soft powdery lime; moderately calcareous; moderately alkaline (pH 8.0); clear wavy boundary.

C2ca—43 to 51 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine and very fine tubular pores; common streaks of soft powdery lime; strongly calcareous; moderately alkaline (pH 8.4); clear wavy boundary.

C3ca—51 to 61 inches; strong brown (7.5YR 5/6) silt loam, reddish yellow (7.5YR 6/6) dry; massive; slightly hard, friable, nonsticky and nonplastic; few fine roots; many very fine tubular pores; few streaks of soft powdery lime; moderately calcareous; moderately alkaline (pH 8.2).

The depth to bedrock is more that 60 inches. The depth to secondary carbonates ranges from 20 to 43 inches. The thickness of the mollic epipedon is 7 to 20 inches. The 10- to 40-inch control section is silt loam and has 18 to 24 percent clay.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist or dry.

The B2 horizon has value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 or 3 when moist or dry.

The Cca horizon has value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or 3 when moist or dry. The lower part of the Cca horizon has chroma of 6 in some pedons.

Ritzville series

The Ritzville series consists of very deep, well drained soils. These soils formed in loess and volcanic ash. The average annual precipitation is about 11 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Ritzville silt loam, 2 to 7 percent slopes, 600 feet west of Oregon Highway I9 and 50 feet north of gravel road, SE1/4SE1/4SE1/4 sec. I5, T. 1 N., R. 21 E.

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly

plastic; many very fine roots; many very fine irregular pores; neutral (pH 7.0); abrupt smooth boundary.
A12—7 to 12 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 7.2); clear gradual boundary.
B2—12 to 31 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; mildly alkaline (pH 7.6); clear gradual boundary.
C1ca—31 to 41 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; weakly calcareous; moderately alkaline (pH 8.0); abrupt wavy boundary.
C2ca—41 to 60 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; strongly calcareous; moderately alkaline (pH 8.4).

The depth to secondary carbonates is 24 to 40 inches. The thickness of the mollic epipedon is 8 to 14 inches.

The Ap horizon has value of 4 or 5 when dry, and chroma of 2 or 3 when dry or moist. It is silt loam or very fine sandy loam.

The B2 horizon has value of 4 or 5 when dry and 3 or 4 when moist.

The Cca horizon has value of 6 or 7 when dry and 4 or 5 when moist.

Rockly series

The Rockly series consists of very shallow, well drained soils. These soils formed in loess, volcanic ash, and basalt residuum. The average annual precipitation is about 16 inches. The average annual air temperature is about 47 degrees F.

Typical pedon of Rockly very cobbly loam, 2 to 20 percent slopes, SE1/4SE1/4NE1/4 sec. 6, T. 6 S., R. 23 E.

A1—0 to 3 inches; dark brown (7.5YR 3/3) very cobbly loam, brown (7.5YR 5/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; 30 percent cobbles, 20 percent pebbles; slightly acid (pH 6.4); clear smooth boundary.
B2—3 to 7 inches; dark brown (7.5YR 3/3) extremely cobbly clay loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; 40 percent cobbles, 30 percent pebbles; slightly acid (pH 6.4); abrupt smooth boundary.
R—7 inches; basalt.

The thickness of the mollic epipedon and the depth to bedrock range from 5 to 12 inches. The solum is loam or clay loam and has 35 to 75 percent rock fragments consisting of pebbles, cobbles, and stones. The hue is 10YR, 7.5YR, or 5YR throughout the profile.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The B2 horizon has value of 3 or 4 when moist.

Roloff series

The Roloff series consists of moderately deep, well drained soils that formed in loess. The average annual precipitation is about 10 inches. The average annual air temperature is about 53 degrees F.

Typical pedon of Roloff silt loam, 2 to 7 percent slopes, 25 feet north of road, SE1/4SW1/4NW1/4 sec. 11, T. 3 N., R. 22 E.

A11—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral (pH 7.0) clear smooth boundary.
A12—2 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral (pH 7.0); clear smooth boundary.
B2—8 to 17 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral (pH 7.0); abrupt smooth boundary.
C—17 to 24 inches; dark brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; 10 percent pebbles 2 to 5 millimeters in diameter; neutral (pH 7.2); abrupt wavy boundary.
R—24 inches; basalt.

The thickness of the solum is 15 to 25 inches. Depth to bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon is 7 to 12 inches. These soils have hue of 7.5YR to 10YR throughout the profile.

The A horizon has chroma of 2 or 3 when dry or moist.

The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3 when dry or moist. It is silt loam or very fine sandy loam.

The C horizon has value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 to 4 when dry or moist. It is silt loam or very fine sandy loam.

Sagehill series

The Sagehill series consists of very deep, well drained soils. These soils formed in loess and calcareous lacustrine sediment. The average annual precipitation is about 9 inches. The average annual air temperature is about 51 degrees F.

Typical pedon of Sagehill fine sandy loam, 5 to 12 percent slopes, 50 feet south of Eightmile Road, NW1/4NW1/4NW1/4 sec. 20, T. 2 N., R. 22 E.

A1—0 to 8 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline (pH 7.4); clear wavy boundary.

B21—8 to 22 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium prismatic structure; soft, friable, nonsticky and nonplastic; many very fine roots; mildly alkaline (pH 7.6); clear wavy boundary.

B22—22 to 25 inches; dark brown (10YR 3/3) very fine sandy loam, pale brown (10YR 6/3) dry; weak medium prismatic structure; slightly hard, friable, nonsticky and nonplastic; few very fine roots; mildly alkaline (pH 7.6); abrupt wavy boundary.

IIC1ca—25 to 35 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; massive hard, friable, slightly sticky and slightly plastic; few very fine roots; many white and light gray streaks and splotches of soft powdery lime; moderately alkaline (pH 8.0); abrupt wavy boundary.

IIIC2ca—35 to 61 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; many white and light gray streaks and splotches of soft powdery lime; moderately alkaline (pH 8.2).

The depth to bedrock is more than 60 inches. The depth to lime is 15 to 30 inches.

The A horizon has value of 5 or 6 when dry and chroma of 2 or 3 when moist or dry.

The B2 horizon has value of 5 or 6 when dry and chroma of 2 or 3 when moist or dry. It is very fine sandy loam or fine sandy loam.

The IIC horizon has value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. It is stratified silt loam or very fine sandy loam.

Schrier series

The Schrier series consists of deep, well drained soils. These soils formed in loess and colluvium and alluvium derived from basalt and shale. The average annual precipitation is about 15 inches. The average annual air temperature is about 47 degrees F.

Typical pedon of Schrier silt loam, shaly substratum, 7 to 12 percent slopes, NE1/4SW1/4SE1/4 sec. 30, T. 5 S., R. 24 E.

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; 5 percent pebbles; neutral (pH 6.8); abrupt smooth boundary.

A12—3 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 5 percent pebbles; neutral (pH 7.0); clear smooth boundary.

A3—12 to 20 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 5 percent pebbles; mildly alkaline (pH 7.6); clear smooth boundary.

B2ca—20 to 26 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 5 percent pebbles; few white lime flecks and streaks; mildly alkaline (pH 7.8); abrupt wavy boundary.

IICca—26 to 50 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; massive; slightly hard and hard, friable and firm, slightly sticky and slightly plastic; common very fine roots in the upper part, few roots in the lower part; 10 percent pebbles; strongly calcareous; many white flecks and mycelia of segregated lime; moderately alkaline (pH 8.20); abrupt wavy boundary.

IICr—50 inches; partially decomposed shale.

The depth to partially decomposed shale is 40 to 60 inches. The thickness of the solum and the mollic epipedon is 20 to 40 inches. The depth to secondary lime is 12 to 30 inches. The 10- to 40-inch control section is loam, silt loam, or clay loam. It has 0 to 15 percent pebbles and more than 15 percent material coarser than very fine sand.

Simas series

The Simas series consists of very deep, well drained soils. These soils formed in loess and colluvium over waterlaid sediment. The average annual precipitation is

about 15 inches. The average annual air temperature is about 47 degrees F. The Simas soils in Gilliam County are taxadjuncts to the Simas series because they do not have an abrupt upper boundary in the argillic horizon, contain less clay, and are in a higher precipitation zone than is common for the Simas series.

Typical pedon for Simas very stony silt loam, 7 to 40 percent south slopes, SE1/4NW1/4SW1/4 sec. 24, T. 5 S., R. 23 E.

A11—0 to 5 inches; very dark grayish brown (10YR 3/2) very stony silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 25 percent cobbles, 10 percent pebbles; neutral (pH 7.2); clear smooth boundary.

A12—5 to 11 inches; very dark grayish brown (10YR 3/2) very cobbly silty clay loam, grayish brown (10YR 5/2) dry; moderate medium and fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; 25 percent cobbles, 10 percent pebbles; weakly calcareous; neutral (pH 7.2); abrupt wavy boundary.

B21t—11 to 17 inches; dark brown (10YR 3/3) cobbly clay, light yellowish brown (10YR 6/4) dry; moderate medium and fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; thin patchy clay films on some ped surfaces; 10 percent cobbles, 10 percent pebbles, weakly calcareous; mildly alkaline (pH 7.8); clear wavy boundary.

B22t—17 to 27 inches; brown (10YR 4/3) cobbly clay, light yellowish brown (10YR 6/4) with white (10YR 8/1) coatings on ped surfaces, dry; moderate medium and fine blocky structure; hard, firm, sticky and plastic; few fine roots; medium nearly continuous clay films; 10 percent cobbles, 10 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); abrupt irregular boundary.

B3tca—27 to 42 inches; dark brown (7.5YR 4/4) cobbly clay, brown (7.5YR 5/4) with common pockets of very pale brown (10YR 8/3) dry; weak medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm, sticky and plastic; few fine roots; medium nearly continuous clay films; 10 percent cobbles, 10 percent pebbles; very strongly calcareous; moderately alkaline (pH 8.2); abrupt irregular boundary.

Cca—42 to 60 inches; yellowish brown (10YR 5/4) very cobbly clay loam, very pale brown (10YR 7/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; 25 percent cobbles, 10 percent pebbles; strongly calcareous; moderately alkaline (pH 8.2).

The depth to bedrock is more than 60 inches. The argillic horizon has 0 to 35 percent coarse fragments. The thickness of the mollic epipedon is 7 to 20 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 or 2 when moist or dry. It has 10 to 30 percent cobbles and stones and 0 to 10 percent pebbles. In some pedons this horizon is calcareous in the lower part.

The B horizon in the upper part has value of 2 or 3 when moist and 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. This horizon in the lower part has value of 3 or 4 when moist, and chroma of 3 or 4 when moist or dry. The B horizon has 40 to 50 percent clay, 0 to 30 percent cobbles, and 0 to 25 percent pebbles. It is weakly calcareous to strongly calcareous.

The C horizon is clay loam or clay and has 20 to 50 percent rock fragments. It is weakly calcareous to strongly calcareous.

Stanfield series

The Stanfield series consists of moderately deep, moderately well drained soils. These soils formed in alluvium from loess and volcanic ash. The average annual precipitation is about 10 inches. The average annual air temperature is about 52 degrees F.

Typical pedon of Stanfield fine sandy loam, NW1/4SW1/4SE1/4 sec. 12, T. 3 N., R. 22 E.

Ap—0 to 10 inches; brown (10YR 4/3) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine irregular pores; many fine flecks of lime and soluble salts; strongly alkaline (pH 8.8); abrupt smooth boundary.

AC—10 to 17 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; hard, firm, slightly sticky and slightly plastic; common fine tubular pores; many fine flecks of lime and soluble salts; strongly alkaline (pH 8.8); abrupt wavy boundary.

C1—17 to 21 inches; brown (10YR 4/3) very fine sandy loam, very pale brown (10YR 7/3) dry; massive; slightly hard, firm, slightly sticky and slightly plastic; common fine tubular pores; disseminated lime; strongly calcareous; strongly alkaline (pH 8.8); abrupt smooth boundary.

C2sim—21 to 33 inches; brown (10YR 4/3) duripan, light gray (10YR 7/2) dry; massive; very hard, very firm, slightly sticky and slightly plastic; strongly cemented hardpan with indurated silica coating on surface and in some pores; common fine tubular pores; many white lime splotches; strongly calcareous; strongly alkaline (pH 8.8); clear wavy boundary.

C3—33 to 60 inches; brown (10YR 4/3) silt loam, light gray (10YR 7/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine irregular pores; many fine flecks of lime; strongly calcareous; strongly alkaline (pH 8.8).

The reaction of the soil ranges from moderately alkaline to very strongly alkaline. The depth to bedrock is more than 60 inches. Depth to the duripan is from 20 to 40 inches.

The A and AC horizons have chroma of 2 or 3 when moist or dry.

The C1 horizon has hue of 10YR or 2.5Y. It has value of 3 or 4 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry.

The duripan ranges from 7 to 20 inches in thickness. Some pedons have a series of duripans and friable horizons between the pans.

Taunton series

The Taunton series consists of moderately deep, somewhat excessively drained soils. These soils formed in old alluvium reworked by wind. The average annual precipitation is about 9 inches. The average annual air temperature is about 50 degrees F.

Typical pedon of Taunton loamy fine sand, 2 to 5 percent slopes, 250 feet west of road, NE1/4NW1/4SW1/4 sec. 2, T. 2 N., R. 22 E.

A1—0 to 4 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak fine granular structure; loose, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline (pH 7.4); clear wavy boundary.

B2—4 to 8 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; loose, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline (pH 7.6); abrupt wavy boundary.

C1ca—8 to 15 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; disseminated lime; moderately calcareous; moderately alkaline (pH 8.0); clear wavy boundary.

C2ca—15 to 21 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; 10 percent duripan fragments; disseminated lime; strongly calcareous; moderately alkaline (pH 8.4); abrupt wavy boundary.

C2casim—21 inches; white (10YR 8/2) strongly cemented, duripan.

The depth to the duripan is 20 to 40 inches.

The A horizon has value of 5 or 6 when dry and chroma of 2 or 3 when moist or dry.

The B2 and C1ca horizons have value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or 3 when moist or dry. The Cca horizon is 0 to 35 percent lime-silica pebbles.

Tub series

The Tub series consists of very deep, well drained soils. These soils formed in loess and colluvium over waterlaid sediment. The average annual precipitation is about 15 inches. The average annual air temperature is about 47 degrees F. The Tub soils in Gilliam County are taxadjuncts to the Tub series because the depth to lime is more than 35 inches.

Typical pedon of Tub stony silty clay loam, 12 to 40 percent slopes, SE1/4NW1/4SE1/4 sec. 3, T. 6 S., R. 24 E.

A11—0 to 3 inches; black (10YR 2/1) stony silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; 0.5 percent stones on the surface; many fine roots; neutral (pH 6.6); gradual wavy boundary.

A12—3 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; 5 percent pebbles; many fine roots; neutral (pH 6.6); abrupt wavy boundary.

B21t—7 to 23 inches; black (10YR 2/1) cobbly clay, very dark gray (10YR 3/1) dry; moderate coarse prismatic structure parting to strong fine and medium subangular blocky; very hard, firm, very sticky and very plastic; 10 percent cobbles, 5 percent pebbles; common thin clay films; neutral (pH 6.8); clear wavy boundary.

B22t—23 to 29 inches; very dark grayish brown (10YR 3/2) cobbly clay, grayish brown (10YR 5/2) dry; moderate coarse prismatic structure parting to strong fine and medium subangular blocky; very hard, firm, very sticky and very plastic; 10 percent cobbles, 5 percent pebbles; few fine roots; common moderately thick clay films; neutral (pH 7.0); clear wavy boundary.

B3t—29 to 37 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; 5 percent pebbles; few fine roots; common moderately thick clay films; mildly alkaline (pH 7.4); clear wavy boundary.

Cca—37 to 60 inches; dark brown (10YR 3/3) silty clay loam, light brownish gray (10YR 6/2) dry; massive; hard, firm, sticky and plastic; 5 percent pebbles; few fine roots; many seams of soft powdery lime; moderately calcareous; moderately alkaline (pH 8.0).

The depth to bedrock is more than 60 inches. The thickness of the mollic epipedon is 20 to 25 inches. The depth to secondary lime is more than 35 inches.

The A horizon is silty clay loam or clay loam and has 0 to 1 percent stones on the surface. It is 10 to 25 percent pebbles.

The B2t horizon is 40 to 60 percent clay.

Ukiah series

The Ukiah series consists of moderately deep, well drained soils. These soils formed in colluvium weathered from volcanic tuff. The average annual precipitation is about 19 inches. The average annual air temperature is about 48 degrees F.

Typical pedon of Ukiah cobbly silty clay loam, 2 to 12 percent slopes, NW1/4SE1/4SE1/4 sec. 32, T. 5 S., R. 23 E.

Ap—0 to 10 inches; very dark brown (10YR 2/2) cobbly silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure parting to weak fine granular; hard, friable, sticky and plastic; common fine roots; 15 percent cobbles, 10 percent pebbles; neutral (pH 7.0); clear smooth boundary.

B2t—10 to 20 inches; dark brown (10YR 3/3) cobbly clay, brown (10YR 4/3) dry; moderate medium prismatic structure parting to strong medium and fine subangular blocky; very hard, friable, very sticky and very plastic; few fine roots; many continuous clay films; 10 percent cobbles, 5 percent pebbles; neutral (pH 7.2); abrupt smooth boundary.

C1—20 to 23 inches; dark brown (7.5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; massive; slightly hard, friable, sticky and plastic; few fine roots; 5 percent pebbles, 5 percent cobbles; mildly alkaline (pH 7.4); clear smooth boundary.

C2—23 to 28 inches; strong brown (7.5YR 5/6) gravelly loam, reddish yellow (7.5YR 7/6) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; 15 percent pebbles; calcareous; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cr—28 inches; semiconsolidated volcanic tuff.

The mollic epipedon is 15 to 30 inches thick. The depth to volcanic tuff is 20 to 40 inches. The soil has cracks in summer most years that are at least 1 centimeter wide at a depth of 20 inches and that extend to the surface.

The A horizon has value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 1 or 2 when moist or dry.

The Bt horizon has chroma of 2 or 3 when moist or dry. The upper part of the Bt horizon has value of 4 or 5 when dry and 2 or 3 when moist, and the lower part has value of 5 or 6 when dry and 3 or 4 when moist. This horizon is 50 to 60 percent clay and 15 to 35 percent rock fragments.

Valby series

The Valby series consists of moderately deep, well drained soils. These soils formed in loess and a small amount of ash. They are underlain by basalt. The average annual precipitation is about 12 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Valby silt loam in an area of Condon and Valby silt loams, 7 to 12 percent slopes, 60 feet south of road, NE1/4SE1/4SE1/4 sec. 34, T. 3 S., R. 20 E.

A11—0 to 2 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; neutral (pH 7.0); abrupt smooth boundary.

A12—2 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral (pH 7.0); gradual wavy boundary.

B1—9 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 4/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral (pH 7.2); clear wavy boundary.

B2—18 to 23 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral (pH 7.2); clear wavy boundary.

C1—23 to 32 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral (pH 7.2); abrupt wavy boundary.

C2ca—32 to 36 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic, few very fine and fine roots; moderately calcareous; 5 percent pebbles, 5 percent cobbles; moderately alkaline (pH 8.3); abrupt wavy boundary.

IIR—36 inches; basalt.

Depth to bedrock is 20 to 40 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The B2 horizon has value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The Cca horizon has value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. It has 0 to 10 percent rock fragments.

Waha series

The Waha series consists of moderately deep, well drained soils. These soils formed in loess. The average

annual precipitation is about 16 inches. The average annual air temperature is about 48 degrees F.

Typical pedon of Waha silt loam in an area of Waha-Rockly complex, 2 to 20 percent slopes, NE1/4SE1/4NW1/4 sec. 21, T. 5 S., R. 24 E.

A11—0 to 6 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; neutral (pH 6.6); clear smooth boundary.

A12—6 to 12 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; neutral (pH 6.6); clear wavy boundary.

B21t—12 to 20 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, sticky and plastic; common fine roots; few thin clay films; neutral (pH 6.8); clear wavy boundary.

B22t—20 to 26 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; common fine roots; 5 percent pebbles; few thin clay films; neutral (pH 7.0); clear wavy boundary.

IIB3—26 to 32 inches; brown (10YR 4/3) extremely cobbly silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable; slightly sticky and slightly plastic; few fine roots; 35 percent pebbles, 35 percent cobbles; mildly alkaline (pH 7.6); abrupt smooth boundary.

IIR—32 inches; basalt.

The depth to bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon is 20 to 30 inches.

The A1 horizon has value of 3 or 4 when dry and 2 when moist, and chroma of 1 or 2 when moist or dry.

The B2t horizon has value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 or 3 when moist or dry.

Walla Walla series

The Walla Walla series consists of very deep, well drained soils. These soils formed in loess. The average annual precipitation is about 13 inches. The average annual air temperature is about 52 degrees F.

Typical pedon of Walla Walla silt loam, 20 to 35 percent north slopes, NW1/4NW1/4NW1/4 sec. 16, T. 2 N., R. 19 E.

A11—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; slightly acid (pH 6.4); clear smooth boundary.

A12—7 to 17 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; neutral (pH 6.8); clear wavy boundary.

B21—17 to 30 inches; dark brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) dry; weak coarse prismatic structure; slightly hard, friable, nonsticky and nonplastic; few fine roots; neutral (pH 7.0); gradual wavy boundary.

B22—30 to 44 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; neutral (pH 7.0); abrupt smooth boundary.

C1ca—44 to 54 inches; brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; moderately calcareous; moderately alkaline (pH 7.9); clear wavy boundary.

C2ca—54 to 67 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; soft, very friable, slightly sticky and slightly plastic; moderately calcareous; moderately alkaline (pH 8.0).

The depth to bedrock is more than 60 inches. The depth to secondary carbonates ranges from 43 to more than 60 inches. The thickness of the mollic epipedon is 10 to 16 inches. The 10- to 40-inch control section is silt loam and has 10 to 18 percent clay.

The A horizon has chroma of 2 or 3 when moist or dry.

Warden series

The Warden series consists of very deep, well drained soils. These soils formed in loess and in the underlying calcareous lacustrine silt. The average annual precipitation is about 9 inches. The average annual air temperature is about 51 degrees F.

Typical pedon of Warden silt loam, 12 to 20 percent slopes, NE1/4SE1/4SE1/4 sec. 22, T. 2 N., R. 22 E.

A1—0 to 3 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral (pH 7.0); clear smooth boundary.

B21—3 to 11 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral (pH 7.2); gradual wavy boundary.

B22—11 to 21 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium prismatic

structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral (pH 7.2); clear wavy boundary.

C1—21 to 30 inches; brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; massive; slightly hard, firm, slightly sticky and slightly plastic; common very fine roots; neutral (pH 7.2); abrupt wavy boundary.

IIC2ca—30 to 53 inches; grayish brown (2.5Y 5/2) silt loam, light gray (10YR 7/2) dry; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; strongly alkaline (pH 8.8); abrupt wavy boundary.

IIIC3ca—53 to 60 inches; dark grayish brown (2.5Y 4/2) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strongly alkaline (pH 9.0).

The depth to lime is 15 to 30 inches. The depth to bedrock is more than 60 inches.

The A horizon has value of 5 or 6 when dry, and chroma of 2 or 3 when moist or dry.

The B2 horizon has value of 5 or 6 when dry, and chroma of 2 or 3 when moist or dry. It is silt loam or very fine sandy loam.

The C horizon has value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. It is stratified silt loam and very fine sandy loam.

Willis series

The Willis series consists of moderately deep, well drained soils. These soils formed in loess. The average annual precipitation is about 10 inches. The average annual air temperature is about 51 degrees F.

Typical pedon of Willis silt loam, 2 to 5 percent slopes, NE1/4NE1/4SE1/4 sec. 25, T. 2 N., R. 21 E.

A1—0 to 2 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral (pH 7.0); clear smooth boundary.

B21—2 to 9 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium and fine prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral (pH 7.2); clear wavy boundary.

B22—9 to 19 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral (pH 7.2); clear wavy boundary.

C1ca—19 to 26 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strongly calcareous; moderately alkaline (pH 8.2); abrupt smooth boundary.

IIC2casim—26 to 60 inches; duripan; massive; indurated with laminar capping.

The depth to the lime-silica cemented hardpan ranges from 20 to 40 inches. The thickness of the mollic epipedon is 12 to 18 inches. Pan fragments are common throughout the profile.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry.

The C horizon has value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 or 3 when moist or dry.

Wrentham series

The Wrentham series consists of moderately deep, well drained soils. These soils formed in loess and colluvium from basalt. The average annual precipitation is about 12 inches. The average annual air temperature is about 49 degrees F.

Typical pedon of Wrentham silt loam in an area of Wrentham-Rock outcrop complex, 35 to 70 precent slopes, SW1/4NW1/4SE1/4 sec. 19, T. 4 S., R. 21 E.

A11—0 to 4 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine irregular pores; neutral (pH 6.8); clear smooth boundary.

A12—4 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 5 percent pebbles; neutral (pH 7.0); clear wavy boundary.

A13—9 to 18 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 10 percent pebbles; neutral (pH 7.0); gradual smooth boundary.

B21—18 to 23 inches; dark brown (10YR 3/3) very gravelly silt loam, brown (10YR 4/3) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common roots; many very fine tubular pores; 30 percent pebbles, 10 percent cobbles; neutral (pH 7.2); gradual smooth boundary.

B22—23 to 33 inches; dark brown (10YR 3/3) very gravelly silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common roots; 50 percent

pebbles, 10 percent cobbles; neutral (pH 7.3); abrupt wavy boundary.
IIR—33 inches; basalt.

The depth to bedrock is 20 to 40 inches. The thickness of the mollic epipedon is 20 to 36 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 or 2 when moist or dry. It has 0 to 10 percent pebbles and 0 to 5 percent cobbles.

The B horizon has value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 2 to 4 when moist or dry.

Xeric Torrifluvents

Xeric Torrifluvents consist of very deep, somewhat excessively drained soils that formed in recent alluvium. The average annual precipitation is about 9 inches. The average annual air temperature is about 51 degrees F.

Reference pedon of Xeric Torrifluvents, nearly level, 100 yards downstream from bridge on Fourmile Canyon, NW1/4NW1/4NW1/4 sec. 21, T. 2 N., R. 22 E.

A1—0 to 6 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; neutral (pH 7.0); clear smooth boundary.
C1—6 to 22 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; many fine roots; neutral (pH 7.0); gradual smooth boundary.
C2—22 to 41 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; common fine roots; neutral (pH 7.2); gradual smooth boundary.
C3—41 to 65 inches; dark brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; few roots; slightly calcareous; mildly alkaline (pH 7.8); clear smooth boundary.
C4—65 to 81 inches; dark brown (10YR 3/3) gravelly loamy sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; mildly alkaline (pH 7.8).

The A horizon is sandy loam or fine sandy loam. This horizon contains 0 to 15 percent pebbles.

The C horizon is fine sandy loam, loamy sand, or loamy fine sand and contains 0 to 50 percent pebbles and cobbles. It is calcareous in some pedons.

Formation of the soils

The factors and processes that formed the soils in Gilliam County and gave them many distinctive characteristics are discussed in this section.

Soils are formed through the interaction of five major factors—climate, plant and animal life, parent material, relief, and time (*5*). The relative influence of each factor varies from place to place, and in some cases, a single factor can determine most properties of a soil. Parent material, climate, and vegetation are the dominant factors in determining the characteristics of the soils in Gilliam County.

Nearly all the county is underlain by Columbia River basalt which was deposited during the Miocene Epoch. In places, these basalt flows built up to a maxium thickness of 4,000 feet, and their weight caused faulting throughout the county. The most important of these is the Columbia River fault, which formed the present drainage pattern of the Columbia River (*4*).

Nearly all soils in the county are influenced to some extent by loess. The loess probably originated from glacial outwash of the receding glaciers and from material deposited by the Columbia River during the Pleistocene.

Geologic events near the end of the Ice Age during the Pleistocene had great influence on the character of several soils. As meltwater from receding glaciers to the north rushed down the Columbia River, it carried debris that dammed the Columbia River Gorge, probably on at least three occasions. In the lakes that formed behind these dams, lacustrine silt was deposited at an elevation up to 1,200 feet. After water in the lakes receded, a mantle of silt and fine sandy loam was deposited by wind over the lacustrine silt. The Warden and Sagehill soils are examples of soils formed in this manner. The climate in the area of these soils is dry. Average annual precipitation is 9 to 10 inches. Consequently, natural vegetation is sparse, and the surface layer of the soil is light colored.

The debris carried by the floodwater included gravel. The gravel was deposited at an elevation up to 1,200 feet, however, thicker layers of the deposits are near the Columbia River. Also, large boulders, known as glacial erratics, were carried on ice rafts by the floodwater (fig. 12). A mantle of loess from glacial outwash areas was deposited over the gravel. The Olex soils formed in this way (fig. 13). Other debris that was carried by the floodwater are pockets of fine textured sediment. This sediment weathered to form soils that have a clay subsoil. The Krebs soils are examples of these soils.

In some areas near the Columbia River, floods during the Pleistocene Epoch completely scoured the landscape, leaving only bare rock. Loess was then deposited directly on the rock. The Roloff and Prosser soils are examples of soils formed in this material.

In areas adjacent to the Columbia River, sandy alluvium was deposited during the Pleistocene floods. The Quincy soils formed in this material. Average annual precipitation in the area of these soils is 7 to 8 inches. Vegetation is sparse, and organic-matter content of the soil is low.

The force of the wind moves soil particles as large as coarse sand. The largest particles are rolled or bounced

Figure 12.—A glacial erratic granite boulder on Roloff-Rock outcrop complex, 1 to 20 percent slopes.

along the surface, and this helps to dislodge other particles and subject them to blowing. The distance the particle is carried depends, in part, on the type of movement and size of the particle. Generally, larger particles are carried only a short distance and are the first to be deposited. The next particles that are deposited downwind from the source are fine and very fine sands and coarse silt. Because of their size and weight, the finer silt and clay particles are carried in suspension for a considerable distance and are deposited furthest from the source. Deposits of windlaid materials usually are deepest when they are close to the source and thinner when they are far from the source.

The Mikkalo, Willis, Nansene, Ritzville, and Walla Walla soils formed in loess in the northern half of the county. These soils are dominated by coarse silt. The Nansene, Ritzville, and Walla Walla soils formed nearer to the source of the loess and are very deep. The moderately deep Mikkalo soils are farther from the source of loess on south- and west-facing exposures. The Willis soils are on level and slightly concave areas and contain a hardpan.

Soils that formed in loess in the rest of the county are Bakeoven, Condon, Gwinly, Lickskillet, Morrow, Rhea, Rockly, Valby, and Waha. These soils are farther from the source of loess and are generally shallower than soils in the northern part of the county. They are dominated by finer silt and have more clay, are in areas of higher precipitation, and have a darker surface layer. Rhea soils are on north-facing exposures and are very deep. Condon and Valby soils are on all exposures and are moderately deep. Morrow and Waha soils are on older surfaces at a higher elevation in the southern part of the county. They are moderately deep and have a distinctive argillic horizon. Bakeoven and Rockly soils formed on rocky ridgetops and near the edges of ridgetops. They are very shallow and have little profile development. Bakeoven soils are near Valby, Condon, and Morrow soils and are commonly interspersed with them in patterns as biscuit-scabland. Rockly soils are in a similar relationship with Waha soils. The origin of these biscuits or mounds is not definitely known, but they possibly were frost wedges that eroded to mounds (*6*).

The light colored Lickskillet soils are on south- and west-facing exposures in the northern three-fourths of the county. They are shallow because of preferential erosion of loess resulting from poor moisture relations and sparse vegetation. The south-facing exposures in the southern fourth of the county are dominated by Gwinly soils. In this part of the county, the basalt is interbedded with volcanic tuff, and the clay subsoil of the Gwinly soils weathered from this tuff. These soils are far from the source of loess and have only a thin mantle of windlaid material.

Wrentham soils are on steep, north-facing exposures. These soils have a thick, dark surface layer.

The Ukiah, Tub, and Simas soils are derived mainly from old volcanic tuff and lakelaid sediment that weather easily into fine textured materials. As a result of weathering, these soils have a clay subsoil. Tub and Simas soils are very deep, and Ukiah soils are moderately deep. These soils are far from the source of loess and are only slightly influenced by it.

The Kahler soils are the only forested soils in the county. These soils formed in basalt colluvium, loess, and volcanic ash on steep, north-facing exposures. The ash originated from the Cascade Mountains. Because of the relatively high precipitation and forest-type vegetation, the soil has a thick, dark surface layer.

The main drainages in the county are the John Day River, Rock Creek, Thirtymile Creek, Willow Creek, and Lonerock Creek. The Hermiston, Kimberly, Powder, and Stanfield soils are along these drainages. These soils formed in alluvial deposits eroded from soils on uplands. Relief and parent material were very significant in the formation of these soils. Stanfield soils formed under dry conditions and have a hardpan. They are high in content of soluble salts and sodium throughout. Powder and Kimberly soils are in the same 10- to 12-inch precipitation zone, but Kimberly soils are coarser textured and consequently more droughty. This results in less vegetation and a thinner, lighter colored surface layer. Powder soils have a thick, dark surface layer. Both soils contain lime in the subsoil. Hermiston soils are in a higher pre-

Figure 13.—A deep roadcut in an area of Olex soils.

cipitation zone and have a thick, dark surface horizon and no lime.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse textured (light textured) soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 to 80 inches (1 or 2 meters).

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the

water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms.

Consolidated bedrock is not yet parent material by this concept.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor*. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root Zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the

underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitaion is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Tuff. A compacted deposit 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water supplying capacity. Water stored in the soil at the beginning of plant growth in spring, plus rainfall not in excess of evapotranspiratation during the growing season, less runoff.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA AT ARLINGTON

[Recorded in the period 1951-73]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	41.5	27.7	34.6	61	-2	115	1.60	.68	2.34	5	4.6
February---	49.6	32.2	40.9	68	12	101	.94	.20	1.51	3	.9
March------	57.1	34.7	45.9	74	16	194	.76	.27	1.15	3	.3
April------	65.9	39.8	52.8	84	24	384	.49	.09	.79	2	.0
May--------	76.4	47.3	61.9	97	31	679	.56	.17	.87	2	.0
June-------	83.6	54.6	69.1	104	41	873	.45	.07	.73	1	.0
July-------	92.3	60.4	76.4	109	46	1,128	.20	---	.36	1	.0
August-----	90.1	59.5	74.8	107	46	1,079	.17	---	.30	1	.0
September--	81.1	51.0	66.1	98	34	783	.44	.12	.68	1	.0
October----	66.5	41.7	54.1	84	23	437	.57	.19	.87	2	.0
November---	50.7	33.7	42.2	66	13	142	1.38	.53	2.06	5	.5
December---	42.6	29.6	36.2	61	6	57	1.66	.70	2.43	6	3.1
Yearly:											
Average--	66.5	42.7	54.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	109	-8	---	---	---	---	---	---
Total----	---	---	---	---	---	5,972	9.22	7.42	10.92	32	9.4

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--TEMPERATURE AND PRECIPITATION DATA AT CONDON

[Recorded in the period 1951-73]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	38.6	23.0	30.9	58	-8	64	1.62	.91	2.19	7	8.8
February---	44.0	27.1	35.6	65	4	55	1.10	.43	1.63	4	5.1
March------	49.2	28.5	38.9	70	13	61	1.20	.45	1.80	5	4.9
April------	56.3	32.0	44.2	77	20	152	.87	.23	1.38	3	1.3
May--------	65.5	39.0	52.3	88	24	386	1.44	.45	2.22	5	.1
June-------	73.8	44.8	59.3	93	32	579	1.13	.33	1.77	3	.0
July-------	83.6	49.5	66.6	99	36	825	.42	---	.70	1	.0
August-----	82.0	48.7	65.4	98	35	787	.45	---	.76	1	.0
September--	73.5	43.3	58.4	92	28	552	.69	.18	1.09	2	.0
October----	61.3	35.8	48.5	83	21	273	.93	.40	1.35	3	.7
November---	46.9	29.3	38.1	67	9	74	1.85	.78	2.70	7	3.9
December---	40.2	24.9	32.6	58	0	17	1.89	.85	2.73	7	6.7
Yearly:											
Average--	59.6	35.5	47.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	101	-15	---	---	---	---	---	---
Total----	---	---	---	---	---	3,825	13.59	11.38	15.69	48	31.5

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 3.--FREEZE DATES IN SPRING AND FALL AT ARLINGTON

[Recorded in the period 1951-73]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 11	April 26	May 11
2 years in 10 later than--	April 1	April 19	May 5
5 years in 10 later than--	March 14	April 7	April 24
First freezing temperature in fall:			
1 year in 10 earlier than--	October 11	October 15	September 21
2 years in 10 earlier than--	October 23	October 21	September 29
5 years in 10 earlier than--	November 16	November 3	October 13

TABLE 4.--FREEZE DATES IN SPRING AND FALL AT CONDON

[Recorded in the period 1951-73]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 9	May 30	June 19
2 years in 10 later than--	May 1	May 24	June 12
5 years in 10 later than--	April 17	May 12	May 29
First freezing temperature in fall:			
1 year in 10 earlier than--	October 8	September 20	August 18
2 years in 10 earlier than--	October 15	September 26	August 30
5 years in 10 earlier than--	October 28	October 9	September 22

TABLE 5.--GROWING SEASON AT ARLINGTON

[Recorded in the period 1951-73]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	200	185	143
8 years in 10	216	194	153
5 years in 10	246	209	171
2 years in 10	277	225	189
1 year in 10	293	234	198

TABLE 6.--GROWING SEASON AT CONDON

[Recorded in the period 1951-73]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	168	125	68
8 years in 10	176	133	84
5 years in 10	193	149	115
2 years in 10	210	164	146
1 year in 10	218	172	162

TABLE 7.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1D	Bakeoven very cobbly loam, 2 to 20 percent slopes	3,792	0.5
2D	Bakeoven-Condon complex, 2 to 20 percent slopes	25,807	3.3
3D	Bakeoven-Morrow complex, 2 to 20 percent slopes	16,734	2.1
4C	Blalock loam, 2 to 12 percent slopes	4,309	0.6
5B	Condon and Valby silt loams, 1 to 7 percent slopes	18,104	2.3
5C	Condon and Valby silt loams, 7 to 12 percent slopes	29,274	3.8
6D	Condon and Valby silt loams, 12 to 20 percent north slopes	7,486	0.9
6E	Condon and Valby silt loams, 20 to 35 percent north slopes	7,978	1.0
7D	Condon and Valby silt loams, 12 to 20 percent south slopes	1,756	0.2
7E	Condon and Valby silt loams, 20 to 30 percent south slopes	313	*
8	Dune land	384	*
9E	Gwinly very cobbly silt loam, 7 to 40 percent slopes	5,590	0.7
10F	Gwinly-Rock outcrop complex, 40 to 70 percent slopes	4,970	0.6
11	Hermiston silt loam	1,042	0.1
12F	Kahler silt loam, bedrock substratum, 35 to 70 percent slopes	816	0.1
13	Kimberly fine sandy loam	3,474	0.4
14B	Krebs silt loam, 2 to 5 percent slopes	2,010	0.3
14D	Krebs silt loam, 5 to 20 percent slopes	5,052	0.6
14E	Krebs silt loam, 20 to 40 percent slopes	917	0.1
15E	Lickskillet very stony loam, 7 to 40 percent slopes	60,014	7.8
16F	Lickskillet-Rock outcrop complex, 40 to 70 percent slopes	94,015	12.2
17B	Mikkalo silt loam, 2 to 7 percent slopes	14,099	1.8
17C	Mikkalo silt loam, 7 to 12 percent slopes	18,940	2.4
17D	Mikkalo silt loam, 12 to 20 percent slopes	5,797	0.7
17E	Mikkalo silt loam, 20 to 40 percent slopes	2,770	0.4
18B	Morrow silt loam, 1 to 7 percent slopes	31,126	4.0
18C	Morrow silt loam, 7 to 12 percent slopes	10,383	1.3
19D	Morrow silt loam, 12 to 20 percent north slopes	4,581	0.6
19E	Morrow silt loam, 20 to 35 percent north slopes	6,848	0.9
20D	Morrow silt loam, 12 to 20 percent south slopes	436	0.1
21E	Morrow-Lickskillet complex, 20 to 30 percent slopes	319	*
22F	Nansene silt loam, 35 to 70 percent slopes	4,494	0.6
23B	Olex silt loam, 0 to 5 percent slopes	11,217	1.4
23C	Olex silt loam, 5 to 12 percent slopes	5,451	0.7
23D	Olex silt loam, 12 to 20 percent slopes	1,796	0.2
24D	Olex gravelly silt loam, 5 to 20 percent slopes	2,267	0.3
24E	Olex gravelly silt loam, 20 to 40 percent slopes	6,070	0.8
25D	Olex-Roloff complex, 5 to 20 percent slopes	1,000	0.1
26	Powder silt loam	668	0.1
27B	Prosser-Rock outcrop complex, 1 to 5 percent slopes	292	*
28B	Quincy loamy fine sand, 0 to 5 percent slopes	947	0.1
29D	Quincy-Rock outcrop complex, 1 to 20 percent slopes	3,372	0.4
30B	Rhea silt loam, 1 to 7 percent slopes	663	0.1
30C	Rhea silt loam, 7 to 12 percent slopes	1,733	0.2
30D	Rhea silt loam, 12 to 20 percent slopes	4,177	0.5
30E	Rhea silt loam, 20 to 40 percent slopes	4,487	0.6
31B	Ritzville very fine sandy loam, 2 to 7 percent slopes	2,411	0.3
31C	Ritzville very fine sandy loam, 7 to 12 percent slopes	1,378	0.2
31D	Ritzville very fine sandy loam, 12 to 20 percent slopes	745	0.1
31E	Ritzville very fine sandy loam, 20 to 40 percent slopes	692	0.1
32A	Ritzville silt loam, 0 to 2 percent slopes	3,824	0.5
32B	Ritzville silt loam, 2 to 7 percent slopes	53,867	7.0
32C	Ritzville silt loam, 7 to 12 percent slopes	48,795	6.4
32D	Ritzville silt loam, 12 to 20 percent slopes	13,420	1.7
33E	Ritzville silt loam, 20 to 40 percent north slopes	10,627	1.4
34E	Ritzville silt loam, 20 to 40 percent south slopes	2,591	0.3
35	Riverwash	1,307	0.2
36F	Rock outcrop-Rubble land complex, very steep	8,158	1.0
37D	Rockly very cobbly loam, 2 to 20 percent slopes	643	0.1
38A	Roloff silt loam, 0 to 2 percent slopes	4,846	0.6
38B	Roloff silt loam, 2 to 7 percent slopes	2,127	0.3
38C	Roloff silt loam, 7 to 12 percent slopes	291	*
39D	Roloff-Rock outcrop complex, 1 to 20 percent slopes	11,894	1.5
40B	Sagehill fine sandy loam, 2 to 5 percent slopes	5,472	0.7
40C	Sagehill fine sandy loam, 5 to 12 percent slopes	5,281	0.7
40D	Sagehill fine sandy loam, 12 to 20 percent slopes	5,248	0.7

See footnote at end of table.

TABLE 7.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
40E	Sagehill fine sandy loam, 20 to 40 percent slopes	1,771	0.2
41B	Sagehill fine sandy loam, hummocky, 2 to 5 percent slopes	1,401	0.2
41C	Sagehill fine sandy loam, hummocky, 5 to 12 percent slopes	1,727	0.2
42B	Schrier silt loam, shaly substratum, 2 to 7 percent slopes	463	0.1
42C	Schrier silt loam, shaly substratum, 7 to 12 percent slopes	394	0.1
43E	Simas very stony silt loam, 7 to 40 percent south slopes	2,528	0.3
44	Stanfield fine sandy loam	181	*
45B	Taunton loamy fine sand, 2 to 5 percent slopes	589	0.1
46C	Tub gravelly clay loam, 1 to 12 percent slopes	1,550	0.2
46E	Tub stony silty clay loam, 12 to 40 percent slopes	2,907	0.4
47C	Ukiah cobbly silty clay loam, 2 to 12 percent slopes	692	0.1
47E	Ukiah cobbly silty clay loam, 12 to 35 percent slopes	580	0.1
48B	Waha silt loam, 1 to 7 percent slopes	1,798	0.2
49D	Waha silt loam, 7 to 25 percent north slopes	3,871	0.5
49E	Waha silt loam, 25 to 40 percent north slopes	3,361	0.4
50D	Waha silt loam, 7 to 25 percent south slopes	1,732	0.2
51D	Waha-Rockly complex, 2 to 20 percent slopes	16,936	2.2
52B	Walla Walla silt loam, 1 to 7 percent slopes	5,064	0.6
52C	Walla Walla silt loam, 7 to 12 percent slopes	3,785	0.5
53D	Walla Walla silt loam, 12 to 20 percent north slopes	1,340	0.2
53E	Walla Walla silt loam, 20 to 35 percent north slopes	432	0.1
54D	Walla Walla silt loam, 12 to 20 percent south slopes	665	0.1
54E	Walla Walla silt loam, 20 to 35 percent south slopes	261	*
55B	Warden silt loam, 2 to 5 percent slopes	6,275	0.8
55C	Warden silt loam, 5 to 12 percent slopes	4,490	0.6
55D	Warden silt loam, 12 to 20 percent slopes	4,887	0.6
55E	Warden silt loam, 20 to 40 percent slopes	7,912	1.0
56B	Willis silt loam, 2 to 5 percent slopes	11,865	1.5
56C	Willis silt loam, 5 to 12 percent slopes	4,838	0.6
56D	Willis silt loam, 12 to 20 percent slopes	1,046	0.1
56E	Willis silt loam, 20 to 30 percent slopes	319	*
57F	Wrentham-Rock outcrop complex, 35 to 70 percent slopes	50,640	6.6
58	Xeric Torrifluvents, nearly level	4,828	0.6
	Water-small	605	0.1
	Water-large	6,400	0.8
	Total	779,520	100.0

* Less than 0.1 percent.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Winter wheat		Barley	Alfalfa hay	Pasture	
	N	I	N	I	N	I
	Bu	Bu	Bu	Ton	AUM*	AUM*
5B---------- Condon and Valby	30	---	40	---	3	---
5C, 6D---------- Condon and Valby	30	---	40	---	3	---
6E---------- Condon and Valby	30	---	40	---	3	---
7D---------- Condon and Valby	20	---	30	---	2	---
7E---------- Condon and Valby	15	---	30	---	2	---
11---------- Hermiston	35	100	65	6.5	---	---
13---------- Kimberly	---	100	---	6	---	13
17B---------- Mikkalo	25	---	30	---	3	12
17C---------- Mikkalo	25	---	30	---	3	12
17D---------- Mikkalo	25	---	30	---	3	12
17E---------- Mikkalo	25	---	30	---	3	---
18B, 18C---------- Morrow	25	---	35	---	3	---
19D, 19E---------- Morrow	25	---	35	---	3	---
20D---------- Morrow	15	---	30	---	---	---
26---------- Powder	25	100	---	6	---	---
28B---------- Quincy	---	100	---	6	---	18
30B---------- Rhea	40	---	40	---	3	---
30C, 30D---------- Rhea	40	---	40	---	3	---
30E---------- Rhea	40	---	40	---	3	---
31B---------- Ritzville	35	100	40	6	---	---

See footnotes at end of table.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Winter wheat		Barley	Alfalfa hay	Pasture	
	N	I	N	I	N	I
	Bu	Bu	Bu	Ton	AUM*	AUM*
31C, 31D---------- Ritzville	35	---	40	---	---	---
31E---------- Ritzville	25	---	30	---	---	---
32A---------- Ritzville	35	100	40	6	---	---
32B---------- Ritzville	35	100	40	6	---	---
32C, 32D---------- Ritzville	35	---	40	---	---	---
33E, 34E---------- Ritzville	25	---	30	---	---	---
38A, 38B, 38C---------- Roloff	25	---	35	---	---	---
40B---------- Sagehill	---	100	---	8	---	21
40C---------- Sagehill	---	100	---	7	---	21
40D---------- Sagehill	---	100	---	6	---	18
42B, 42C---------- Schrier	30	---	---	3	3	8
44---------- Stanfield	---	---	---	4	2	12
46C---------- Tub	25	---	---	---	1.3	---
47C---------- Ukiah	30	---	---	---	---	---
48B---------- Waha	25	---	40	---	4	---
49D---------- Waha	35	---	45	---	4	---
49E---------- Waha	---	---	---	---	---	---
50D---------- Waha	25	---	40	---	4	---
52B---------- Walla Walla	55	100	55	6	---	---
52C---------- Walla Walla	55	100	50	6	---	---
53D, 53E---------- Walla Walla	55	---	45	---	---	---

See footnotes at end of table.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Winter wheat		Barley	Alfalfa hay	Pasture	
	N	I	N	I	N	I
	Bu	Bu	Bu	Ton	AUM*	AUM*
54D---------- Walla Walla	45	---	30	---	---	---
54E---------- Walla Walla	35	---	---	---	---	---
55B---------- Warden	20	100	---	8	---	---
55C---------- Warden	20	100	---	8	---	---
55D---------- Warden	20	100	---	6	---	---
56B---------- Willis	25	---	---	---	---	14
56C---------- Willis	25	---	---	---	---	12
56D---------- Willis	25	---	---	---	---	---
58**---------- Xeric Torrifluvents	---	90	---	5	---	12

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation are listed]

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
1D---------- Bakeoven	Shrubby Scabland----------	Favorable	500	Stiff sagebrush----------	70
		Normal	400	Sandberg bluegrass----------	20
		Unfavorable	300		
2D*:					
Bakeoven----------	Shrubby Scabland----------	Favorable	500	Stiff sagebrush----------	70
		Normal	400	Sandberg bluegrass----------	20
		Unfavorable	300		
Condon----------	Biscuit----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
3D*:					
Bakeoven----------	Shrubby Scabland----------	Favorable	500	Stiff sagebrush----------	70
		Normal	400	Sandberg bluegrass----------	20
		Unfavorable	300		
Morrow----------	Biscuit----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
4C---------- Blalock	Droughty Rolling Hills--------	Favorable	700	Bluebunch wheatgrass----------	65
		Normal	650	Sandberg bluegrass----------	25
		Unfavorable	200		
5B*, 5C*:					
Condon----------	Rolling Hills----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
Valby----------	Rolling Hills----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
6D*, 6E*:					
Condon----------	Droughty North Exposure-------	Favorable	950	Bluebunch wheatgrass----------	45
		Normal	800	Idaho fescue----------	30
		Unfavorable	400	Sandberg bluegrass----------	10
				Thurber needlegrass----------	
Valby----------	Droughty North Exposure-------	Favorable	950	Bluebunch wheatgrass----------	45
		Normal	800	Idaho fescue----------	30
		Unfavorable	400	Sandberg bluegrass----------	10
				Thurber needlegrass----------	5
7D*, 7E*:					
Condon----------	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Longleaf phlox----------	5
Valby----------	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Longleaf phlox----------	5
9E---------- Gwinly	South Exposure----------	Favorable	1,400	Bluebuch wheatgrass----------	65
		Normal	1,300	Idaho fescue----------	5
		Unfavorable	600	Sandberg bluegrass----------	10
10F*:					
Gwinly----------	Steep South----------	Favorable	600	Bluebunch wheatgrass----------	70
		Normal	600	Idaho fescue----------	5
		Unfavorable	250	Sandberg bluegrass----------	5
Rock outcrop.					

See footnote at end of table.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
11---------- Hermiston	Semimoist Bottom----------	Favorable Normal Unfavorable	1,400 1,200 1,000	Giant wildrye---------- Bluebunch wheatgrass---------- Idaho fescue----------	50 8 5
14B, 14D---------- Krebs	Droughty Rolling Hills---------	Favorable Normal Unfavorable	700 650 200	Bluebunch wheatgrass---------- Sandberg bluegrass----------	65 25
14E---------- Krebs	Droughty South Exposure-------	Favorable Normal Unfavorable	850 700 350	Bluebunch wheatgrass---------- Sandberg bluegrass---------- Phlox---------- Thurber needlegrass----------	75 10 5 5
15E---------- Lickskillet	Droughty South Exposure-------	Favorable Normal Unfavorable	850 700 350	Bluebunch wheatgrass---------- Sandberg bluegrass---------- Thurber needlegrass---------- Phlox----------	75 10 5 5
16F*: Lickskillet------- Rock outcrop.	Droughty South Exposure-------	Favorable Normal Unfavorable	850 700 350	Bluebunch wheatgrass---------- Sandberg bluegrass---------- Thurber needlegrass---------- Phlox----------	75 10 5 5
17B, 17C, 17D------ Mikkalo	Droughty Rolling Hills---------	Favorable Normal Unfavorable	700 650 200	Bluebunch wheatgrass---------- Sandberg bluegrass----------	65 25
17E---------- Mikkalo	Droughty South Exposure-------	Favorable Normal Unfavorable	850 700 350	Bluebunch wheatgrass---------- Sandberg bluegrass---------- Phlox---------- Thurber needlegrass----------	75 10 5 5
18B, 18C---------- Morrow	Rolling Hills----------	Favorable Normal Unfavorable	900 750 400	Bluebunch wheatgrass---------- Idaho fescue---------- Sandberg bluegrass----------	45 35 10
19D, 19E---------- Morrow	North Exposure----------	Favorable Normal Unfavorable	1,300 1,000 650	Idaho fescue---------- Bluebunch wheatgrass---------- Cusick bluegrass----------	70 15 5
20D---------- Morrow	South Exposure----------	Favorable Normal Unfavorable	1,400 1,300 600	Bluebunch wheatgrass---------- Idaho fescue---------- Sandberg bluegrass----------	55 20 10
21E*: Morrow---------- Lickskillet------- 22F---------- Nansene	South Exposure---------- Droughty South Exposure------- North Exposure----------	Favorable Normal Unfavorable Favorable Normal Unfavorable Favorable Normal Unfavorable	1,400 1,300 600 850 700 350 1,450 1,300 700	Bluebunch wheatgrass---------- Idaho fescue---------- Sandberg bluegrass---------- Bluebunch wheatgrass---------- Sandberg bluegrass---------- Thurber needlegrass---------- Phlox---------- Idaho fescue---------- Bluebunch wheatgrass---------- Sandberg bluegrass----------	55 20 10 75 10 5 5 70 15 5
23B, 23C---------- Olex	Droughty Rolling Hills---------	Favorable Normal Unfavorable	700 650 200	Bluebunch wheatgrass---------- Sandberg bluegrass----------	65 25

See footnote at end of table.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
23D---------- Olex	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
				Phlox----------	5
24D, 24E---------- Olex	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
				Phlox----------	5
25D*:					
Olex----------	Droughty Rolling Hills--------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
				Phlox----------	5
Roloff----------	Light Loamy Terrace----------	Favorable	900	Needleandthread----------	55
		Normal	700	Bluebunch wheatgrass----------	20
		Unfavorable	300	Indian ricegrass----------	10
27B*:					
Prosser----------	Light Loamy Terrace----------	Favorable	900	Needleandthread----------	55
		Normal	700	Bluebunch wheatgrass----------	20
		Unfavorable	300	Indian ricegrass----------	10
Rock outcrop.					
29D*:					
Quincy----------	Loamy Sand Terrace----------	Favorable	900	Needleandthread----------	60
		Normal	700	Indian ricegrass----------	20
		Unfavorable	475	Antelope bitterbrush----------	5
Rock outcrop.					
30B, 30C---------- Rhea	Rolling Hills----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
30D, 30E---------- Rhea	Droughty North Exposure-------	Favorable	950	Bluebunch wheatgrass----------	45
		Normal	800	Idaho fescue----------	30
		Unfavorable	300	Sandberg bluegrass----------	10
31B, 31C, 31D------ Ritzville	Droughty Rolling Hills--------	Favorable	950	Bluebunch wheatgrass----------	65
		Normal	650	Sandberg bluegrass----------	25
		Unfavorable	400		
31E---------- Ritzville	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
32A, 32B, 32C, 32D- Ritzville	Droughty Rolling Hills--------	Favorable	700	Bluebunch wheatgrass----------	65
		Normal	650	Sandberg bluegrass----------	25
		Unfavorable	200		
33E---------- Ritzville	Droughty North Exposure-------	Favorable	950	Idaho fescue----------	30
		Normal	800	Bluebunch wheatgrass----------	45
		Unfavorable	300	Sandberg bluegrass----------	10
34E---------- Ritzville	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5

See footnote at end of table.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
37D---------- Rockly	Scabland----------	Favorable	400	Sandberg bluegrass----------	80
		Normal	350	Bluebunch wheatgrass----------	5
		Unfavorable	150		
38A, 38B, 38C------ Roloff	Droughty Rolling Hills--------	Favorable	900	Needleandthread----------	55
		Normal	700	Bluebunch wheatgrass----------	20
		Unfavorable	300	Indian ricegrass----------	10
39D*:					
Roloff----------	Droughty Rolling Hills--------	Favorable	900	Needleandthread----------	55
		Normal	700	Bluebunch wheatgrass----------	20
		Unfavorable	300	Indian ricegrass----------	10
Rock outcrop.					
40B, 40C, 40D------ Sagehill	Sand Loam Terrace----------	Favorable	850	Bluebunch wheatgrass----------	60
		Normal	700	Sandberg bluegrass----------	15
		Unfavorable	450	Needleandthread----------	10
40E---------- Sagehill	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
41B, 41C---------- Sagehill	Sand Loam Terrace----------	Favorable	850	Bluebunch wheatgrass----------	60
		Normal	700	Sandberg bluegrass----------	15
		Unfavorable	450	Needleandthread----------	10
42B, 42C---------- Schrier	Rolling Hills----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
43E---------- Simas	South Exposure----------	Favorable	1,400	Bluebunch wheatgrass----------	60
		Normal	1,300	Idaho fescue----------	20
		Unfavorable	600	Sandberg bluegrass----------	10
45B---------- Taunton	Light Loamy Terrace----------	Favorable	700	Needleandthread----------	65
		Normal	450	Bluebunch wheatgrass----------	5
		Unfavorable	300	Indian ricegrass----------	5
				Gray rabbitbrush----------	5
46C---------- Tub	Rolling Hills----------	Favorable	900	Bluebunch wheatgrass----------	45
		Normal	750	Idaho fescue----------	35
		Unfavorable	400	Sandberg bluegrass----------	10
46E---------- Tub	North Exposure----------	Favorable	1,300	Idaho fescue----------	70
		Normal	1,000	Bluebunch wheatgrass----------	15
		Unfavorable	650	Cusick bluegrass----------	5
47C---------- Ukiah	Moist Rolling Hills----------	Favorable	1,500	Idaho fescue----------	70
		Normal	1,400	Bluebunch wheatgrass----------	10
		Unfavorable	700	Sandberg bluegrass----------	5
47E---------- Ukiah	South Exposure----------	Favorable	1,300	Bluebunch wheatgrass----------	55
		Normal	1,200	Idaho fescue----------	20
		Unfavorable	550	Sandberg bluegrass----------	10
48B---------- Waha	Moist Rolling Hills----------	Favorable	1,500	Idaho fescue----------	70
		Normal	1,400	Bluebunch wheatgrass----------	10
		Unfavorable	700	Sandberg bluegrass----------	5
49D, 49E---------- Waha	North Exposure----------	Favorable	1,300	Idaho fescue----------	70
		Normal	1,000	Bluebunch wheatgrass----------	15
		Unfavorable	650	Cusick bluegrass----------	5

See footnote at end of table.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
50D---------- Waha	South Exposure----------	Favorable	1,400	Bluebunch wheatgrass----------	55
		Normal	1,300	Idaho fescue----------	20
		Unfavorable	600	Sandberg bluegrass----------	10
51D*:					
Waha----------	Biscuit (moist)----------	Favorable	1,300	Idaho fescue----------	70
		Normal	1,000	Bluebunch wheatgrass----------	15
		Unfavorable	650	Cusick bluegrass----------	5
Rockly----------	Scabland----------	Favorable	400	Sandberg bluegrass----------	80
		Normal	350	Bluebunch wheatgrass----------	5
		Unfavorable	150		
52B, 52C---------- Walla Walla	Rolling Hills----------	Favorable	1,000	Idaho fescue----------	65
		Normal	800	Bluebunch wheatgrass----------	20
		Unfavorable	350	Sandberg bluegrass----------	10
53D---------- Walla Walla	North Exposure----------	Favorable	1,300	Idaho fescue----------	70
		Normal	1,000	Bluebunch wheatgrass----------	15
		Unfavorable	650	Sandberg bluegrass----------	5
53E---------- Walla Walla	North Exposure----------	Favorable	1,300	Idaho fescue----------	70
		Normal	1,000	Bluebunch wheatgrass----------	15
		Unfavorable	650	Sandberg bluegrass----------	5
54D---------- Walla Walla	South Exposure----------	Favorable	1,400	Idaho fescue----------	20
		Normal	1,300	Bluebunch wheatgrass----------	55
		Unfavorable	600	Sandberg bluegrass----------	10
54E---------- Walla Walla	South Exposure----------	Favorable	1,400	Bluebunch wheatgrass----------	55
		Normal	1,300	Idaho fescue----------	20
		Unfavorable	600	Sandberg bluegrass----------	10
55B, 55C, 55D, 55E- Warden	Silty Terrace----------	Favorable	650	Bluebunch wheatgrass----------	70
		Normal	500	Sandberg bluegrass----------	20
		Unfavorable	200		
56B, 56C, 56D------ Willis	Droughty Rolling Hills--------	Favorable	700	Bluebunch wheatgrass----------	65
		Normal	650	Sandberg bluegrass----------	25
		Unfavorable	200		
56E---------- Willis	Droughty South Exposure-------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
				Phlox----------	5
57F*:					
Wrentham----------	North----------	Favorable	1,450	Idaho fescue----------	70
		Normal	1,300	Bluebunch wheatgrass----------	15
		Unfavorable	700	Sandberg bluegrass----------	5
Rock outcrop.					
58*---------- Xeric Torrifluvents	Light Loamy Terrace----------	Favorable	900	Needleandthread----------	55
		Normal	750	Bluebunch wheatgrass----------	20
		Unfavorable	450	Indian ricegrass----------	10
				Sandberg bluegrass----------	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
11---------- Hermiston	Siberian peashrub, lilac, Nanking cherry.	Green ash, Russian-olive, Austrian pine, ponderosa pine, Rocky Mountain juniper.	---	Black locust------	---
28B---------- Quincy	---	Siberian peashrub, Nanking cherry, multiflora rose.	Russian-olive-----	Austrian pine, ponderosa pine, Scotch pine, Douglas-fir, green ash, blue spruce.	Lombardy poplar.
29D*: Quincy----------	---	Siberian peashrub, Nanking cherry, northern white-cedar, multiflora rose.	Russian-olive-----	Austrian pine, ponderosa pine, Scotch pine, Douglas-fir, green ash, blue spruce.	Lombardy poplar.
Rock outcrop.					
40B, 40C, 40D, 40E, 41B, 41C---- Sagehill	---	---	Black locust------	Russian mulberry	Idahybrid poplar.
44---------- Stanfield	---	---	Russian-olive-----	---	---
45B---------- Taunton	---	---	---	Black locust, Russian mulberry.	Idahybrid poplar.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1D Bakeoven	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
2D*: Bakeoven	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Condon	Severe: depth to rock.	Moderate: slope, low strength, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.
3D*: Bakeoven	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Morrow	Severe: depth to rock.	Moderate: slope, depth to rock, shrink-swell.	Severe: depth to rock.	Severe: slope.	Severe: frost action.
4C Blalock	Severe: cemented pan.	Moderate: cemented pan, slope.	Severe: cemented pan.	Severe: slope.	Moderate: slope, cemented pan, frost action.
5B*: Condon	Severe: depth to rock.	Moderate: low strength, depth to rock.	Severe: depth to rock.	Moderate: slope, low strength, depth to rock.	Severe: frost action.
Valby	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: frost action.
5C*: Condon	Severe: depth to rock.	Moderate: slope, low strength, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.
Valby	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.
6D*, 6E*, 7D*, 7E*: Condon	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: frost action, slope.
Valby	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, frost action.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--*Continued*

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
8*. Dune land					
9E---------- Gwinly	Severe: depth to rock, large stones, too clayey.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.
10F*: Gwinly---------- Rock outcrop.	Severe: depth to rock, large stones, too clayey.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.
11---------- Hermiston	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, floods, frost action.
12F---------- Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
13---------- Kimberly	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
14B---------- Krebs	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
14D---------- Krebs	Moderate: slope, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: low strength, shrink-swell.
14E---------- Krebs	Severe: slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
15E---------- Lickskillet	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.
16F*: Lickskillet------ Rock outcrop.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.
17B---------- Mikkalo	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, low strength.
17C---------- Mikkalo	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.
17D, 17E---------- Mikkalo	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
18B---------- Morrow	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: slope, depth to rock, shrink-swell.	Severe: frost action.
18C---------- Morrow	Severe: depth to rock.	Moderate: slope, depth to rock, shrink-swell.	Severe: depth to rock.	Severe: slope.	Severe: frost action.
19D, 19E, 20D----- Morrow	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, frost action.
21E*: Morrow----------	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, frost action.
Lickskillet------	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.
22F---------- Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.
23B---------- Olex	Severe: cutbanks cave.	Slight----------	Slight----------	Slight----------	Moderate: low strength, frost action.
23C---------- Olex	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, frost action, slope.
23D---------- Olex	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
24D---------- Olex	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, frost action, slope.
24E---------- Olex	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
25D*: Olex----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, frost action, slope.
Roloff----------	Severe: depth to rock.	Moderate: slope, depth to rock, low strength.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock, frost action.
26---------- Powder	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
27B*: Prosser	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, frost action, low strength.
Rock outcrop.					
28B--- Quincy	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
29D*: Quincy	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Rock outcrop.					
30B--- Rhea	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.
30C--- Rhea	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.
30D, 30E--- Rhea	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.
31B--- Ritzville	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.
31C--- Ritzville	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.
31D, 31E--- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.
32A--- Ritzville	Slight	Slight	Slight	Slight	Severe: frost action.
32B--- Ritzville	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.
32C--- Ritzville	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.
32D, 33E, 34E--- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.
35*. Riverwash					
36F*: Rock outcrop.					
Rubble land.					
37D--- Rockly	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
38A--- Roloff	Severe: depth to rock.	Moderate: depth to rock, low strength.	Severe: depth to rock.	Moderate: depth to rock, low strength.	Moderate: depth to rock, low strength, frost action.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
38B---------- Roloff	Severe: depth to rock.	Moderate: depth to rock, low strength.	Severe: depth to rock.	Moderate: slope, depth to rock, low strength.	Moderate: depth to rock, low strength, frost action.
38C---------- Roloff	Severe: depth to rock.	Moderate: slope, depth to rock, low strength.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock, frost action.
39D*: Roloff----------	Severe: depth to rock.	Moderate: slope, depth to rock, low strength.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock, frost action.
Rock outcrop.					
40B---------- Sagehill	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: low strength, frost action.
40C---------- Sagehill	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.
40D, 40E---------- Sagehill	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
41B---------- Sagehill	Moderate: complex slope.	Moderate: complex slope.	Moderate: complex slope.	Moderate: complex slope.	Moderate: low strength, frost action.
41C---------- Sagehill	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.
42B---------- Schrier	Slight----------	Slight----------	Slight----------	Moderate: slope.	Moderate: low strength, frost action.
42C---------- Schrier	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.
43E---------- Simas	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.
44---------- Stanfield	Moderate: cemented pan.	Slight----------	Moderate: cemented pan.	Slight----------	Moderate: low strength.
45B---------- Taunton	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.
46C---------- Tub	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.
46E---------- Tub	Severe: slope.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
47C---------- Ukiah	Severe: depth to rock.	Severe: low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: low strength, shrink-swell.
47E---------- Ukiah	Severe: slope, depth to rock.	Severe: slope, low strength, shrink-swell.	Severe: slope, depth to rock, low strength.	Severe: slope, depth to rock, low strength.	Severe: slope, low strength, shrink-swell.
48B---------- Waha	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, low strength, frost action.
49D, 49E, 50D----- Waha	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
51D*:					
Waha----------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock, frost action.
Rockly----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
52B---------- Walla Walla	Slight----------	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Severe: frost action.
52C---------- Walla Walla	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Severe: frost action.
53D, 53E, 54D, 54E---------- Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, slope.
55B---------- Warden	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: low strength, frost action.
55C---------- Warden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength, frost action.
55D, 55E---------- Warden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
56B---------- Willis	Moderate: cemented pan.	Slight----------	Moderate: cemented pan.	Slight----------	Moderate: low strength, frost action.
56C---------- Willis	Moderate: cemented pan, slope.	Moderate: slope.	Moderate: cemented pan, slope.	Severe: slope.	Moderate: slope, low strength, frost action.
56D, 56E---------- Willis	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
57F*: Wrentham	Severe: slope, depth to rock, large stones.	Severe: slope.	Severe: slope, depth to rock, large stones.	Severe: slope.	Severe: slope, large stones.
Rock outcrop.					
58*. Xeric Torrifluvents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1D---------- Bakeoven	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, large stones, area reclaim.
2D*:					
Bakeoven----------	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, large stones, area reclaim.
Condon----------	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Fair: slope, thin layer, area reclaim.
3D*:					
Bakeoven----------	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, large stones, area reclaim.
Morrow----------	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Fair: slope, thin layer, area reclaim.
4C---------- Blalock	Severe: cemented pan.	Severe: cemented pan, slope.	Severe: cemented pan.	Slight----------	Poor: thin layer, area reclaim.
5B*:					
Condon----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, area reclaim.
Valby----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, area reclaim.
5C*:					
Condon----------	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Valby----------	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
6D*:					
Condon----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Valby----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
6E*:					
Condon----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
6E*:					
Valby	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
7D*:					
Condon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Valby	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
7E*:					
Condon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Valby	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
8*. Dune land					
9E Gwinly	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones, too clayey.	Severe: slope.	Poor: slope, thin layer, area reclaim.
10F*:					
Gwinly	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones, too clayey.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Rock outcrop.					
11 Hermiston	Moderate: floods.	Moderate: seepage.	Moderate: seepage, floods.	Moderate: seepage, floods.	Good.
12F Kahler	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
13 Kimberly	Moderate: floods.	Severe: floods, seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
14B Krebs	Severe: percs slowly.	Moderate: slope, depth to rock.	Severe: depth to rock.	Slight	Fair: too clayey, thin layer.
14D Krebs	Severe: percs slowly.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Fair: too clayey, thin layer, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14E---------- Krebs	Severe: slope, percs slowly.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
15E---------- Lickskillet	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope.	Poor: slope, large stones, thin layer.
16F*: Lickskillet-------- Rock outcrop.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope.	Poor: slope, large stones, thin layer.
17B---------- Mikkalo	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, area reclaim.
17C---------- Mikkalo	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
17D---------- Mikkalo	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope.	Poor: thin layer, area reclaim, slope.
17E---------- Mikkalo	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: thin layer, area reclaim, slope.
18B---------- Morrow	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, area reclaim.
18C---------- Morrow	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
19D---------- Morrow	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
19E---------- Morrow	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
20D---------- Morrow	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
21E*: Morrow---------- Lickskillet--------	Severe: slope, depth to rock, percs slowly. Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock. Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock. Severe: slope, depth to rock, large stones.	Severe: slope. Severe: slope.	Poor: slope, thin layer, area reclaim. Poor: slope, large stones, thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
22F Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
23B Olex	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Poor: small stones.
23C Olex	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Poor: small stones.
23D Olex	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: small stones, slope.
24D Olex	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Poor: small stones.
24E Olex	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
25D*: Olex	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Poor: small stones.
Roloff	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Fair: slope, thin layer, area reclaim.
26 Powder	Moderate: floods.	Moderate: seepage.	Moderate: floods.	Moderate: floods.	Good.
27B*: Prosser	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer.
Rock outcrop.					
28B Quincy	Slight	Severe: seepage.	Severe: too sandy.	Slight	Poor: too sandy.
29D*: Quincy	Moderate: slope.	Severe: slope, seepage.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
Rock outcrop.					
30B Rhea	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
30C Rhea	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
30D Rhea	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
30E Rhea	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
31B Ritzville	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
31C---------- Ritzville	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
31D---------- Ritzville	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
31E---------- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
32A---------- Ritzville	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Good.
32B---------- Ritzville	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
32C---------- Ritzville	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
32D---------- Ritzville	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
33E, 34E---------- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
35*. Riverwash					
36F*: Rock outcrop.					
Rubble land.					
37D---------- Rockly	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, small stones, area reclaim.
38A, 38B---------- Roloff	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, area reclaim.
38C---------- Roloff	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
39D*: Roloff----------	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Rock outcrop.					
40B---------- Sagehill	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
40C---------- Sagehill	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
40D---------- Sagehill	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
40E--- Sagehill	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
41B--- Sagehill	Moderate: percs slowly.	Moderate: slope, seepage.	Slight---	Slight---	Good.
41C--- Sagehill	Moderate: slope, percs slowly.	Severe: slope.	Slight---	Moderate: slope.	Fair: slope.
42B--- Schrier	Severe: depth to rock.	Moderate: seepage, slope, depth to rock.	Severe: depth to rock.	Slight---	Fair: thin layer, area reclaim.
42C--- Schrier	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Fair: thin layer, area reclaim, slope.
43E--- Simas	Severe: percs slowly, slope, large stones.	Severe: slope, large stones.	Severe: too clayey, small stones, large stones.	Severe: slope.	Poor: large stones, slope, too clayey.
44--- Stanfield	Severe: cemented pan.	Severe: cemented pan.	Slight---	Severe: cemented pan.	Poor: thin layer, area reclaim.
45B--- Taunton	Severe: cemented pan.	Severe: cemented pan, seepage.	Severe: cemented pan.	Slight---	Poor: thin layer.
46C--- Tub	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight---	Fair: too clayey.
46E--- Tub	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
47C--- Ukiah	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Slight---	Poor: thin layer, area reclaim.
47E--- Ukiah	Severe: depth to rock, percs slowly, slope.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
48B--- Waha	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight---	Poor: thin layer, area reclaim.
49D--- Waha	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
49E--- Waha	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
50D--- Waha	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
51D*:					
Waha	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Rockly	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, large stones, area reclaim.
52B Walla Walla	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
52C Walla Walla	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
53D Walla Walla	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
53E Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
54D Walla Walla	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
54E Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
55B Warden	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
55C Warden	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
55D Warden	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
55E Warden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
56B Willis	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Poor: thin layer, area reclaim.
56C Willis	Severe: cemented pan.	Severe: slope, cemented pan.	Severe: cemented pan.	Moderate: slope.	Poor: thin layer, area reclaim.
56D, 56E Willis	Severe: cemented pan.	Severe: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Poor: slope, thin layer, area reclaim.
57F*:					
Wrentham	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope.	Poor: slope, large stones, thin layer.
Rock outcrop.					
58*. Xeric Torrifluvents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1D---------- Bakeoven	Poor: area reclaim, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: thin layer, large stones, area reclaim.
2D*:				
Bakeoven----------	Poor: area reclaim, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: thin layer, large stones, area reclaim.
Condon----------	Poor: area reclaim, thin layer, frost action.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: slope, thin layer, area reclaim.
3D*:				
Bakeoven----------	Poor: area reclaim, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: thin layer, large stones, area reclaim.
Morrow----------	Poor: thin layer, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey, thin layer.
4C---------- Blalock	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: thin layer, area reclaim.
5B*:				
Condon----------	Poor: area reclaim, thin layer, frost action.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: thin layer, area reclaim.
Valby----------	Poor: area reclaim, frost action, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: thin layer, area reclaim.
5C*:				
Condon----------	Poor: area reclaim, thin layer, frost action.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: slope, thin layer, area reclaim.
Valby----------	Poor: area reclaim, frost action, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: slope, thin layer, area reclaim.
6D*:				
Condon----------	Poor: area reclaim, thin layer, frost action.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
Valby----------	Poor: area reclaim, frost action, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
6E*:				
Condon	Poor: slope, frost action, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
Valby	Poor: slope, area reclaim, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
7D*:				
Condon	Poor: area reclaim, thin layer, frost action.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
Valby	Poor: area reclaim, frost action, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
7E*:				
Condon	Poor: slope, frost action, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
Valby	Poor: slope, area reclaim, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
8*. Dune land				
9E---- Gwinly	Poor: large stones, thin layer, low strength.	Unsuited: large stones, thin layer, excess fines.	Unsuited: large stones, thin layer, excess fines.	Poor: slope, large stones, thin layer.
10F*:				
Gwinly	Poor: large stones, thin layer, low strength.	Unsuited: large stones, thin layer, excess fines.	Unsuited: large stones, thin layer, excess fines.	Poor: slope, large stones, thin layer.
Rock outcrop.				
11---- Hermiston	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
12F---- Kahler	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
13---- Kimberly	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
14B---- Krebs	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
14D---- Krebs	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
14E Krebs	Poor: slope, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
15E Lickskillet	Poor: large stones, thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: thin layer, excess fines.	Poor: thin layer, large stones, area reclaim.
16F*: Lickskillet	Poor: slope, large stones, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: thin layer, excess fines.	Poor: thin layer, large stones, area reclaim.
Rock outcrop.				
17B Mikkalo	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
17C Mikkalo	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, slope.
17D Mikkalo	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
17E Mikkalo	Poor: thin layer, slope, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
18B Morrow	Poor: thin layer, frost action, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer, area reclaim.
18C Morrow	Poor: thin layer, frost action, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey, thin layer.
19D Morrow	Poor: thin layer, frost action, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
19E Morrow	Poor: slope, thin layer, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
20D Morrow	Poor: thin layer, frost action, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
21E*: Morrow	Poor: slope, thin layer, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
21E*:				
Lickskillet	Poor: slope, large stones, thin layer.	Unsuited: excess fines, thin layer.	Unsuited: thin layer, excess fines.	Poor: thin layer, large stones, area reclaim.
22F				
Nansene	Poor: slope, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
23B, 23C				
Olex	Good	Unsuited: excess fines.	Fair: excess fines.	Poor: small stones.
23D				
Olex	Fair: slope.	Unsuited: excess fines.	Fair: excess fines.	Poor: small stones, slope.
24D				
Olex	Good	Unsuited: excess fines.	Fair: excess fines.	Poor: small stones.
24E				
Olex	Poor: slope.	Unsuited: excess fines.	Fair: excess fines.	Poor: small stones, slope.
25D*:				
Olex	Good	Unsuited: excess fines.	Fair: excess fines.	Poor: small stones.
Roloff	Poor: thin layer.	Unsuited	Unsuited	Fair: slope, area reclaim.
26				
Powder	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
27B*:				
Prosser	Poor: thin layer.	Unsuited	Unsuited	Fair: thin layer.
Rock outcrop.				
28B				
Quincy	Good	Poor: excess fines.	Unsuited: too sandy.	Poor: too sandy.
29D*:				
Quincy	Good	Poor: excess fines.	Unsuited: too sandy.	Poor: too sandy.
Rock outcrop.				
30B				
Rhea	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
30C				
Rhea	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
30D				
Rhea	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
30E				
Rhea	Poor: slope, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
31B				
Ritzville	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
31C				
Ritzville	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
31D---------- Ritzville	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
31E---------- Ritzville	Poor: frost action, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
32A, 32B---------- Ritzville	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
32C---------- Ritzville	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
32D---------- Ritzville	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
33E, 34E---------- Ritzville	Poor: frost action, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
35*. Riverwash				
36F*: Rock outcrop.				
Rubble land.				
37D---------- Rockly	Poor: area reclaim, thin layer.	Unsuited: excess fines.	Poor: excess fines.	Poor: thin layer, small stones, area reclaim.
38A, 38B---------- Roloff	Poor: thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: thin layer. area reclaim.
38C---------- Roloff	Poor: thin layer.	Unsuited: excess fines. thin layer.	Unsuited: excess fines. thin layer.	Fair: slope, thin layer, area reclaim.
39D*: Roloff----------	Poor: thin layer.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: slope, thin layer, area reclaim.
Rock outcrop.				
40B---------- Sagehill	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
40C---------- Sagehill	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
40D---------- Sagehill	Fair: low strength, frost action, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
40E---------- Sagehill	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
41B---------- Sagehill	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
41C---------- Sagehill	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
42B---------- Schrier	Fair: thin layer, area reclaim, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
42C---------- Schrier	Fair: thin layer, area reclaim, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
43E---------- Simas	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones, slope.
44---------- Stanfield	Poor: thin layer, area reclaim.	Unsuited: thin layer, excess fines.	Unsuited: excess fines, thin layer.	Poor: excess sodium, thin layer, area reclaim.
45B---------- Taunton	Poor: thin layer.	Unsuited: thin layer.	Unsuited: excess fines, thin layer.	Fair: thin layer, area reclaim.
46C---------- Tub	Poor: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones.
46E---------- Tub	Poor: slope, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
47C---------- Ukiah	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
47E---------- Ukiah	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, large stones.
48B---------- Waha	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: thin layer, area reclaim.
49D---------- Waha	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
49E---------- Waha	Poor: slope, thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
50D---------- Waha	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
51D*: Waha----------	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: slope, thin layer, area reclaim.
Rockly----------	Poor: area reclaim, thin layer.	Unsuited: excess fines, thin layer.	Poor: excess fines, thin layer.	Poor: thin layer, small stones, area reclaim.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
52B---------- Walla Walla	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
52C---------- Walla Walla	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
53D---------- Walla Walla	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
53E---------- Walla Walla	Poor: slope, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
54D---------- Walla Walla	Poor: frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
54E---------- Walla Walla	Poor: slope, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
55B---------- Warden	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
55C---------- Warden	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
55D---------- Warden	Fair: low strength, slope, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
55E---------- Warden	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
56B---------- Willis	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: area reclaim, thin layer.
56C---------- Willis	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Fair: slope, area reclaim, thin layer.
56D, 56E---------- Willis	Poor: thin layer, area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines, thin layer.	Poor: slope.
57F*: Wrentham----------	Poor: slope, thin layer, large stones.	Unsuited: excess fines.	Poor: excess fines.	Poor: slope, small stones.
Rock outcrop.				
58*. Xeric Torrifluvents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1D---------- Bakeoven	Slope, depth to rock	Thin layer----	Slope, depth to rock.	Rooting depth, slope.	Depth to rock, slope.	Rooting depth, slope.
2D*: Bakeoven---------	Slope, depth to rock	Thin layer----	Slope, depth to rock.	Rooting depth, slope.	Depth to rock, slope.	Rooting depth, slope.
Condon----------	Slope, depth to rock	Thin layer, piping.	Slope----------	Slope, rooting depth.	Depth to rock	Rooting depth.
3D*: Bakeoven---------	Slope, depth to rock	Thin layer----	Slope, depth to rock.	Rooting depth, slope.	Depth to rock, slope.	Rooting depth, slope.
Morrow----------	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Depth to rock	Droughty, erodes easily, rooting depth.
4C---------- Blalock	Cemented pan, slope.	Thin layer----	Cemented pan, slope.	Slope, rooting depth, erodes easily.	Cemented pan, erodes easily.	Erodes easily, rooting depth.
5B*: Condon----------	Depth to rock	Hard to pack, low strength, piping.	Slope----------	Slope, rooting depth.	Depth to rock	Rooting depth.
Valby----------	Depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock	Rooting depth.
5C*: Condon----------	Slope, depth to rock	Thin layer, piping.	Slope----------	Slope, rooting depth.	Depth to rock	Rooting depth.
Valby----------	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock	Rooting depth.
6D*, 6E*, 7D*, 7E*: Condon----------	Slope, depth to rock	Thin layer, piping.	Slope----------	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
Valby----------	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
8*. Dune land						
9E---------- Gwinly	Slope, depth to rock	Thin layer, large stones.	Depth to rock, slope.	Large stones, rooting depth, slope.	Slope, large stones, depth to rock.	Slope, large stones, rooting depth.
10F*: Gwinly----------	Slope, depth to rock	Thin layer, large stones.	Depth to rock, slope.	Large stones, rooting depth, slope.	Slope, large stones, depth to rock.	Slope, large stones, rooting depth.
Rock outcrop.						

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
11---------- Hermiston	Seepage-------	Piping--------	Favorable------	Favorable------	Favorable------	Favorable.
12F---------- Kahler	Slope, depth to rock	Piping--------	Depth to rock, slope.	Slope, erodes easily.	Slope, depth to rock.	Slope, erodes easily.
13---------- Kimberly	Seepage-------	Seepage, piping.	Cutbanks cave	Favorable------	Favorable------	Favorable.
14B---------- Krebs	Depth to rock	Thin layer----	Percs slowly---	Percs slowly---	Percs slowly---	Erodes easily, percs slowly.
14D, 14E---------- Krebs	Slope, depth to rock	Thin layer----	Percs slowly, slope.	Percs slowly, slope.	Slope, percs slowly.	Slope, erodes easily, percs slowly.
15E---------- Lickskillet	Slope, depth to rock	Thin layer, large stones.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock, large stones, slope.	Rooting depth, large stones, slope.
16F*: Lickskillet------	Slope, depth to rock	Thin layer, large stones.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock, large stones, slope.	Rooting depth, large stones, slope.
Rock outcrop.						
17B, 17C---------- Mikkalo	Depth to rock, seepage.	Thin layer----	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Depth to rock, erodes easily.	Rooting depth.
17D, 17E---------- Mikkalo	Depth to rock, seepage.	Thin layer----	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Slope, depth to rock.	Slope, rooting depth.
18B---------- Morrow	Depth to rock	Piping, thin layer.	Depth to rock	Slope, rooting depth, erodes easily.	Depth to rock	Droughty, erodes easily, rooting depth.
18C---------- Morrow	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Depth to rock	Droughty, erodes easily, rooting depth.
19D, 19E, 20D----- Morrow	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Slope, depth to rock.	Slope, rooting depth, erodes easily.
21E*: Morrow----------	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Slope, depth to rock.	Slope, rooting depth, erodes easily.
Lickskillet------	Slope, depth to rock	Thin layer, large stones.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock, large stones, slope.	Rooting depth, large stones, slope.
22F---------- Nansene	Slope---------	Piping--------	Slope----------	Slope----------	Slope, erodes easily.	Slope, erodes easily.
23B---------- Olex	Seepage-------	Seepage-------	Favorable------	Droughty, erodes easily.	Erodes easily	Droughty, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
23C---------- Olex	Seepage-------	Seepage-------	Slope----------	Slope, droughty, erodes easily.	Erodes easily	Droughty, erodes easily, slope.
23D---------- Olex	Seepage-------	Seepage-------	Slope----------	Slope, droughty, erodes easily.	Erodes easily, slope.	Droughty, erodes easily, slope.
24D, 24E---------- Olex	Seepage-------	Seepage-------	Slope----------	Slope, droughty, erodes easily.	Slope----------	Droughty, erodes easily, slope.
25D*: Olex----------	Seepage-------	Seepage-------	Slope----------	Slope, droughty, erodes easily.	Slope----------	Droughty, erodes easily, slope.
Roloff----------	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Slope, depth to rock, piping.	Slope, erodes easily, rooting depth.
26---------- Powder	Seepage-------	Piping--------	Favorable------	Favorable------	Favorable------	Favorable.
27B*: Prosser----------	Depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Depth to rock, erodes easily.	Erodes easily.
Rock outcrop.						
28B---------- Quincy	Slope, seepage.	Piping, seepage.	Slope, cutbanks cave.	Complex slope, soil blowing, droughty.	Soil blowing, too sandy.	Droughty.
29D*: Quincy----------	Slope, seepage.	Piping, seepage.	Slope, cutbanks cave.	Complex slope, soil blowing, droughty.	Slope, soil blowing, too sandy.	Droughty.
Rock outcrop.						
30B---------- Rhea	Seepage-------	Piping--------	Frost action---	Slope, erodes easily.	Erodes easily	Erodes easily.
30C---------- Rhea	Slope, seepage.	Piping--------	Slope, frost action.	Slope, erodes easily.	Erodes easily	Erodes easily.
30D, 30E---------- Rhea	Slope, seepage.	Piping--------	Slope, frost action.	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
31B---------- Ritzville	Seepage-------	Piping--------	Frost action---	Complex slope, erodes easily.	Erodes easily	Erodes easily.
31C, 31D, 31E----- Ritzville	Slope, seepage.	Piping--------	Slope, frost action.	Complex slope, erodes easily.	Complex slope, erodes easily.	Complex slope, erodes easily.
32A, 32B---------- Ritzville	Seepage-------	Piping--------	Frost action---	Complex slope, erodes easily.	Erodes easily	Erodes easily.
32C, 32D, 33E, 34E---------- Ritzville	Slope, seepage.	Piping--------	Slope, frost action.	Complex slope, erodes easily.	Complex slope, erodes easily.	Complex slope, erodes easily.
35*. Riverwash						

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
36F*: Rock outcrop. Rubble land.						
37D---- Rockly	Slope, depth to rock	Thin layer----	Depth to rock, slope.	Rooting depth, slope, large stones.	Large stones, depth to rock.	Large stones, rooting depth, slope.
38A---- Roloff	Depth to rock	Piping, thin layer.	Depth to rock	Rooting depth	Depth to rock, piping, erodes easily.	Rooting depth, erodes easily.
38B---- Roloff	Depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Depth to rock, piping, erodes easily.	Rooting depth, erodes easily.
38C---- Roloff	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Slope, depth to rock, piping.	Slope, erodes easily, rooting depth.
39D*: Roloff----	Slope, depth to rock	Piping, thin layer.	Slope, depth to rock.	Slope, rooting depth, erodes easily.	Slope, depth to rock, piping.	Slope, erodes easily, rooting depth.
Rock outcrop.						
40B---- Sagehill	Slope, seepage.	Piping----	Slope----	Slope, erodes easily, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
40C, 40D, 40E---- Sagehill	Slope, seepage.	Piping----	Slope----	Slope, erodes easily, soil blowing.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
41B---- Sagehill	Slope, seepage.	Piping----	Slope----	Slope, erodes easily, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
41C---- Sagehill	Slope, seepage.	Piping----	Slope----	Slope, erodes easily, soil blowing.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
42B---- Schrier	Seepage, depth to rock	Piping----	Slope, depth to rock.	Slope, erodes easily.	Favorable----	Erodes easily.
42C---- Schrier	Seepage, depth to rock slope.	Piping----	Slope, depth to rock.	Slope, erodes easily.	Favorable----	Erodes easily, slope.
43E---- Simas	Slope----	Large stones--	Slope, large stones.	Slope, percs slowly, large stones.	Large stones, slope, percs slowly.	Large stones, slope, percs slowly.
44---- Stanfield	Cemented pan	Piping, thin layer.	Excess sodium--	Excess sodium, rooting depth.	Cemented pan---	Excess sodium, rooting depth.
45B---- Taunton	Cemented pan, seepage.	Thin layer, piping.	Slope, cemented pan.	Slope, rooting depth, erodes easily.	Cemented pan, rooting depth.	Cemented pan.
46C---- Tub	Favorable----	Piping----	Slope, percs slowly.	Slope, rooting depth, slow intake.	Depth to rock, too clayey, percs slowly.	Rooting depth, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
46E---------- Tub	Slope---------	Piping--------	Slope, percs slowly.	Slope, rooting depth, slow intake.	Slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.
47C---------- Ukiah	Slope, depth to rock	Thin layer----	Slope, percs slowly, large stones.	Slope, percs slowly, slow intake.	Percs slowly, large stones.	Percs slowly, large stones.
47E---------- Ukiah	Slope, depth to rock	Thin layer----	Slope, percs slowly, large stones.	Slope, percs slowly, slow intake.	Slope, percs slowly, large stones.	Slope, percs slowly, large stones.
48B---------- Waha	Depth to rock	Thin layer----	Slope, depth to rock.	Slope, rooting depth.	Depth to rock	Rooting depth.
49D, 49E, 50D----- Waha	Slope, depth to rock	Thin layer----	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
51D*:						
Waha----------	Slope, depth to rock	Thin layer----	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
Rockly----------	Slope, depth to rock	Thin layer----	Slope, depth to rock.	Slope, rooting depth.	Large stones, depth to rock.	Large stones, rooting depth, slope.
52B---------- Walla Walla	Favorable-----	Piping--------	Slope----------	Slope, erodes easily.	Erodes easily--	Erodes easily.
52C, 53D, 53E, 54D, 54E--------- Walla Walla	Slope---------	Piping--------	Slope----------	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
55B---------- Warden	Favorable-----	Piping--------	Slope----------	Slope, erodes easily.	Erodes easily	Erodes easily.
55C, 55D, 55E----- Warden	Slope---------	Slope, piping.	Slope----------	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
56B---------- Willis	Cemented pan	Thin layer, piping.	Slope, cemented pan.	Slope, rooting depth, erodes easily.	Cemented pan, erodes easily.	Rooting depth, erodes easily.
56C, 56D, 56E----- Willis	Slope, cemented pan.	Thin layer, piping.	Slope, cemented pan.	Slope, rooting depth, erodes easily.	Slope, cemented pan, erodes easily.	Slope, rooting depth, erodes easily.
57F*:						
Wrentham---------	Slope---------	Large stones, piping.	Slope----------	Slope----------	Slope, large stones, depth to rock.	Slope, large stones.
Rock outcrop.						
58*. Xeric Torrifluvents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1D---------- Bakeoven	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: slope, depth to rock, large stones.	Severe: large stones.
2D*:				
Bakeoven----------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: slope, depth to rock, large stones.	Severe: large stones.
Condon----------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
3D*:				
Bakeoven----------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: slope, depth to rock, large stones.	Severe: large stones.
Morrow----------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
4C---------- Blalock	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, cemented pan.	Moderate: dusty.
5B*:				
Condon----------	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.
Valby----------	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.
5C*:				
Condon----------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Valby----------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
6D*:				
Condon----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
Valby----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
6E*:				
Condon----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valby----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
7D*:				
Condon	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Valby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
7E*:				
Condon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
8*.				
Dune land				
9E	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones.
Gwinly				
10F*:				
Gwinly	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones.
Rock outcrop.				
11	Severe: floods.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Hermiston				
12F	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kahler				
13	Severe: floods.	Slight	Slight	Slight.
Kimberly				
14B	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Krebs				
14D	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Krebs				
14E	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Krebs				
15E	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, depth to rock.
Lickskillet				
16F*:				
Lickskillet	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.
Rock outcrop.				

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
17B--Mikkalo	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.
17C--Mikkalo	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
17D--Mikkalo	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
17E--Mikkalo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
18B--Morrow	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
18C--Morrow	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
19D--Morrow	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
19E--Morrow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
20D--Morrow	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
21E*:				
Morrow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lickskillet	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.
22F--Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
23B--Olex	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
23C--Olex	Moderate: dusty, slope.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
23D--Olex	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: dusty, slope.
24D--Olex	Moderate: slope, small stones, dusty.	Moderate: slope, small stones, dusty.	Severe: slope, small stones.	Moderate: dusty, small stones.
24E--Olex	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
25D*:				
Olex	Moderate: slope, small stones, dusty.	Moderate: slope, small stones, dusty.	Severe: slope, small stones.	Moderate: dusty, small stones.
Roloff	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
26--- Powder	Moderate: floods, dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
27B*:				
Prosser	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty, depth to rock.	Moderate: dusty.
Rock outcrop.				
28B--- Quincy	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
29D*:				
Quincy	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
Rock outcrop.				
30B--- Rhea	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
30C--- Rhea	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
30D--- Rhea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
30E--- Rhea	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
31B--- Ritzville	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
31C--- Ritzville	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
31D--- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
31E--- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
32A, 32B--- Ritzville	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
32C--- Ritzville	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
32D---------- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
33E, 34E---------- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
35*. Riverwash				
36F*: Rock outcrop.				
Rubble land.				
37D---------- Rockly	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones.
38A---------- Roloff	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, depth to rock.	Moderate: dusty.
38B---------- Roloff	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty, depth to rock.	Moderate: dusty.
38C---------- Roloff	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
39D*: Roloff----------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Rock outcrop.				
40B---------- Sagehill	Slight----------	Slight----------	Moderate: slope.	Slight.
40C---------- Sagehill	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
40D---------- Sagehill	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
40E---------- Sagehill	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
41B---------- Sagehill	Slight----------	Slight----------	Moderate: slope.	Slight.
41C---------- Sagehill	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
42B---------- Schrier	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
42C---------- Schrier	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
43E--- Simas	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, large stones, too clayey.
44--- Stanfield	Moderate: dusty, excess salt.	Moderate: dusty, excess salt.	Moderate: dusty, percs slowly, excess salt.	Moderate: dusty.
45B--- Taunton	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
46C--- Tub	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight.
46E--- Tub	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
47C--- Ukiah	Severe: large stones.	Moderate: large stones, percs slowly.	Severe: slope, large stones.	Severe: large stones.
47E--- Ukiah	Severe: slope, large stones.	Severe: slope.	Severe: slope, large stones.	Moderate: slope, large stones.
48B--- Waha	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.
49D--- Waha	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
49E--- Waha	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
50D--- Waha	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
51D*:				
Waha---	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Rockly---	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones.
52B--- Walla Walla	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
52C--- Walla Walla	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
53D--- Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
53E--- Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
54D---------- Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
54E---------- Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
55B---------- Warden	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
55C---------- Warden	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
55D---------- Warden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
55E---------- Warden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
56B---------- Willis	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty, cemented pan.	Moderate: dusty.
56C---------- Willis	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
56D---------- Willis	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: slope, dusty.
56E---------- Willis	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: slope.
57F*: Wrentham----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.				
58*. Xeric Torrifluvents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1D---------- Bakeoven	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
2D*: Bakeoven----------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
Condon----------	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
3D*: Bakeoven----------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
Morrow----------	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Fair.
4C---------- Blalock	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
5B*, 5C*: Condon----------	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
Valby----------	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
6D*, 6E*: Condon----------	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
Valby----------	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
7D*, 7E*: Condon----------	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
Valby----------	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
8*. Dune land									
9E---------- Gwinly	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
10F*: Gwinly----------	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Rock outcrop.									
11---------- Hermiston	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
12F---------- Kahler	Very poor	Very poor	Good	Good	Very poor	Very poor	Very poor	Very poor	
13---------- Kimberly	Good	Good	Good	Good	Poor	Very poor	Good	Poor	

See footnote at end of table.

TABLE 16.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
14B, 14D, 14E--Krebs	Very poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Very poor	Poor.
15E--Lickskillet	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
16F*:									
Lickskillet	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop.									
17B, 17C, 17D, 17E--Mikkalo	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
18B, 18C, 19D, 19E, 20D--Morrow	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Fair.
21E*:									
Morrow	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Fair.
Lickskillet	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
22F--Nansene	Very poor	Very poor	Good	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
23B, 23C, 23D, 24D, 24E--Olex	Poor	Fair	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
25D*:									
Olex	Poor	Fair	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
Roloff	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
26--Powder	Good	Good	Good	Good	Fair	Fair	Good	Fair	Good.
27B*:									
Prosser	Poor	Poor	Good	Fair	Very poor	Very poor	Very poor	Very poor	Good.
Rock outcrop.									
28B--Quincy	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
29D*:									
Quincy	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop.									
30B--Rhea	Fair	Good	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
30C, 30D, 30E--Rhea	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Poor.
31B, 31C, 31D--Ritzville	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.

See footnote at end of table.

TABLE 16.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
31E---------- Ritzville	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
32A, 32B, 32C, 32D- Ritzville	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
33E, 34E---------- Ritzville	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
35*. Riverwash									
36F*: Rock outcrop.									
Rubble land.									
37D---------- Rockly	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
38A, 38B, 38C------ Roloff	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
39D*: Roloff----------	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Rock outcrop.									
40B, 40C, 40D, 40E, 41B, 41C---------- Sagehill	Very poor	Very poor	Good	Good	Very poor	Very poor	Poor	Very poor	Good.
42B, 42C---------- Schrier	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
43E---------- Simas	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
44---------- Stanfield	Poor	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Poor.
45B---------- Taunton	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
46C---------- Tub	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
46E---------- Tub	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
47C---------- Ukiah	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
47E---------- Ukiah	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
48B, 49D---------- Waha	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
49E---------- Waha	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
50D---------- Waha	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.

See footnote at end of table.

TABLE 16.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
51D*:									
Waha	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Rockly	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
52B Walla Walla	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
52C, 53D, 53E, 54D, 54E Walla Walla	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
55B, 55C, 55D Warden	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
55E Warden	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
56B, 56C Willis	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
56D, 56E Willis	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
57F*:									
Wrentham	Very poor	Very poor	Good	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop.									
58*. Xeric Torrifluvents									

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1D---------- Bakeoven	0-6	Very cobbly loam	GM-GC, GM, SM-SC, SM	A-4	25-55	65-80	60-75	50-70	35-50	25-35	5-10
	6-10	Very cobbly clay loam, very cobbly loam, very gravelly loam.	GM	A-6	15-55	50-65	45-60	40-55	35-50	35-40	10-15
	10	Unweathered bedrock.									
2D*:											
Bakeoven----------	0-6	Very cobbly loam	GM-GC, GM SM-SC, SM	A-4	25-55	65-80	60-75	50-70	35-50	25-35	5-10
	6-10	Very cobbly clay loam, very cobbly loam, very gravelly loam.	GM	A-6	15-55	50-65	45-60	40-55	35-50	35-40	10-15
	10	Unweathered bedrock.									
Condon----------	0-31	Silt loam-------	ML, CL-ML	A-4	0	100	100	90-100	80-90	25-35	5-10
	31	Unweathered bedrock.									
3D*:											
Bakeoven----------	0-6	Very cobbly loam	GM-GC, GM SM-SC, SM	A-4	25-55	65-80	60-75	50-70	35-50	25-35	5-10
	6-10	Very cobbly clay loam, very cobbly loam, very gravelly loam.	GM	A-6	15-55	50-65	45-60	40-55	35-50	35-40	10-15
	10	Unweathered bedrock.									
Morrow----------	0-9	Silt loam-------	ML	A-4	0	95-100	95-100	90-100	80-90	30-35	5-10
	9-13	Silty clay loam	CL	A-6	0	95-100	95-100	90-100	80-95	35-40	15-20
	13-38	Silt loam, silty clay loam.	ML	A-4	0	95-100	95-100	90-100	80-90	30-35	5-10
	38	Unweathered bedrock.									
4C---------- Blalock	0-7	Loam----------	ML	A-4	0	95-100	95-100	80-95	55-80	---	NP
	7-18	Gravelly loam, loam.	ML, SM, GM	A-4	0	60-95	55-90	45-90	35-75	---	NP
	18-22	Cemented--------	---	---	---	---	---	---	---	---	---
	22-41	Gravelly loam---	ML, SM, GM	A-4	0	60-80	55-75	45-70	35-55	---	NP
	41	Weathered bedrock.									
5B*, 5C*, 6D*, 6E*, 7D*, 7E*:											
Condon----------	0-31	Silt loam-------	ML, CL-ML	A-4	0	100	100	90-100	80-90	25-35	5-10
	31	Unweathered bedrock.									
Valby----------	0-9	Silt loam-------	ML, CL-ML	A-4	0	95-100	95-100	85-100	80-90	25-35	5-10
	9-36	Silt loam-------	ML, CL-ML	A-4	0-5	95-100	95-100	85-100	80-90	25-35	5-10
	36	Unweathered bedrock.									

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
8*. Dune land											
9E---------- Gwinly	0-6	Very cobbly silt loam.	ML	A-4	30-50	75-95	70-90	65-90	60-85	25-30	NP-5
	6-10	Very cobbly silty clay loam.	CL	A-6	45-55	65-85	60-80	55-80	50-75	35-40	15-20
	10-14	Very cobbly clay	CH, GC	A-7	45-85	55-80	50-75	45-75	40-70	50-60	25-35
	14	Unweathered bedrock.									
10F*:											
Gwinly----------	0-6	Very cobbly silt loam.	ML	A-4	30-50	75-95	70-90	65-90	60-85	25-30	NP-5
	6-10	Very cobbly silty clay loam.	CL	A-6	45-55	65-85	60-80	55-80	50-75	35-40	15-20
	10-14	Very cobbly clay	CH, GC	A-7	45-85	55-80	50-75	45-75	40-70	50-60	25-35
	14	Unweathered bedrock.									
Rock outcrop.											
11---------- Hermiston	0-31	Silt loam-------	ML	A-4	0	100	100	95-100	70-90	---	NP
	31-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	70-90	---	NP
12F---------- Kahler	0-23	Silt loam-------	ML	A-4	0-10	90-95	85-90	70-90	50-85	30-40	5-10
	23-50	Cobbly silt loam, cobbly loam.	ML, SM	A-4	10-30	75-95	65-80	50-70	40-60	30-40	5-10
	50	Unweathered bedrock.									
13---------- Kimberly	0-13	Fine sandy loam	ML, SM	A-4, A-2	0	100	100	60-90	30-70	---	NP
	13-60	Sandy loam, fine sandy loam.	SM	A-4, A-2	0	100	100	60-80	30-50	---	NP
14B, 14D, 14E------ Krebs	0-5	Silt loam-------	ML	A-4	0	95-100	95-100	90-100	85-90	30-35	5-10
	5-17	Silty clay loam	CL	A-6	0	95-100	95-100	90-100	85-95	35-40	15-20
	17-27	Silty clay, clay	CL, CH	A-7	0	95-100	95-100	90-100	85-95	40-55	25-35
	27-48	Silty clay loam	CL	A-6	0	95-100	95-100	90-100	80-95	35-40	15-20
	48	Weathered bedrock.									
15E---------- Lickskillet	0-3	Very stony loam	GM-GC, CL-ML	A-4	10-50	60-90	60-85	50-80	35-65	25-30	5-10
	3-15	Very gravelly clay loam, very gravelly loam, very cobbly loam.	GC	A-2, A-6, A-7	15-50	40-65	25-50	20-50	15-40	35-45	15-20
	15	Unweathered bedrock.									
16F*:											
Lickskillet-------	0-3	Very stony loam	GM-GC, CL-ML	A-4	10-50	60-90	60-85	50-80	35-65	25-30	5-10
	3-15	Very gravelly clay loam, very gravelly loam, very cobbly loam.	GC	A-2, A-6, A-7	15-50	40-65	25-50	20-50	15-40	35-45	15-20
	15	Unweathered bedrock.									

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
16F*: Rock outcrop.											
17B, 17C, 17D, 17E-Mikkalo	0-16	Silt loam	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	16-38	Silt loam	ML	A-4	0	100	95-100	95-100	80-90	20-30	NP-5
	38	Unweathered bedrock.									
18B, 18C, 19D, 19E, 20D-Morrow	0-9	Silt loam	ML	A-4	0	95-100	95-100	90-100	80-90	30-35	5-10
	9-20	Silty clay loam	CL	A-6	0	95-100	95-100	90-100	80-95	35-40	15-20
	20-38	Silt loam, silty clay loam.	ML	A-4	0	95-100	95-100	90-100	80-90	30-35	5-10
	38	Unweathered bedrock.									
21E*: Morrow	0-9	Silt loam	ML	A-4	0	95-100	95-100	90-100	80-90	30-35	5-10
	9-20	Silty clay loam	CL	A-6	0	95-100	95-100	90-100	80-95	35-40	15-20
	20-38	Silt loam, silty clay loam.	ML	A-4	0	95-100	95-100	90-100	80-90	30-35	5-10
	38	Unweathered bedrock.									
Lickskillet	0-3	Very stony loam	GM-GC, CL-ML	A-4	10-50	60-90	60-85	50-80	35-65	25-30	5-10
	3-15	Very gravelly clay loam, very gravelly loam, very cobbly loam.	GC	A-2, A-6, A-7	15-50	40-65	25-50	20-50	15-40	35-45	15-20
	15	Unweathered bedrock.									
22F-Nansene	0-21	Silt loam	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
	21-60	Silt loam	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
23B, 23C, 23D-Olex	0-12	Silt loam	ML	A-4	0	95-100	95-100	85-100	65-90	---	NP
	12-24	Gravelly silt loam.	GM, ML	A-4	0-10	55-80	50-75	45-75	40-70	---	NP
	24-60	Very gravelly loam, very gravelly silt loam.	GM	A-1, A-2	0-15	20-40	15-35	15-35	10-30	---	NP
24D, 24E-Olex	0-12	Gravelly silt loam.	GM, ML	A-4	0	65-80	60-75	55-75	40-70	---	NP
	12-24	Gravelly silt loam.	GM, ML	A-4	0-10	55-80	50-75	45-75	40-70	---	NP
	24-60	Very gravelly loam, very gravelly silt loam.	GM	A-1, A-2	0-15	20-40	15-35	15-35	10-30	---	NP
25D*: Olex	0-12	Gravelly silt loam.	GM, ML	A-4	0	65-80	60-75	55-75	40-70	---	NP
	12-24	Gravelly silt loam.	GM, ML	A-4	0-10	55-80	50-75	45-75	40-70	---	NP
	24-60	Very gravelly loam, very gravelly silt loam.	GM	A-1, A-2	0-15	20-40	15-35	15-35	10-30	---	NP

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
25D*:											
Roloff	0-8	Silt loam	ML	A-4	0-5	95-100	90-95	80-90	65-80	20-30	NP-5
	8-24	Silt loam, very fine sandy loam.	ML	A-4	5-15	90-100	70-95	65-80	55-80	20-30	NP-5
	24	Unweathered bedrock.									
26	0-13	Silt loam	ML	A-4	0	100	100	90-100	85-95	20-25	NP-5
Powder	13-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	90-100	80-100	50-90	20-25	NP-5
27B*:											
Prosser	0-3	Silt loam	ML	A-4	0	100	95-100	85-95	50-90	20-30	NP-5
	3-25	Very fine sandy loam, silt loam.	ML	A-4	0-5	95-100	90-100	80-90	50-85	20-30	NP-5
	25	Unweathered bedrock.									
Rock outcrop.											
28B	0-14	Loamy fine sand	SM	A-2	0	100	100	75-100	15-30	---	NP
Quincy	14-62	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	15-30	---	NP
29D*:											
Quincy	0-14	Loamy fine sand	SM	A-2	0	100	100	90-100	15-30	---	NP
	14-62	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	90-100	15-30	---	NP
Rock outcrop.											
30B, 30C, 30D, 30E-	0-17	Silt loam	ML	A-4	0	100	90-100	80-100	75-90	25-30	NP-5
Rhea	17-61	Silt loam	ML, CL-ML	A-4	0	95-100	90-100	80-100	80-90	25-35	5-10
31B, 31C, 31D, 31E-	0-12	Very fine sandy loam.	ML	A-4	0	100	95-100	95-100	75-100	20-30	NP-5
Ritzville	12-41	Silt loam	ML, CL-ML	A-4	0	100	100	95-100	80-100	20-30	NP-10
	41-60	Silt loam	ML	A-4	0	100	100	95-100	80-100	20-30	NP-5
32A, 32B, 32C, 32D,											
33E, 34E	0-12	Silt loam	ML	A-4	0	100	95-100	95-100	75-100	20-30	NP-5
Ritzville	12-41	Silt loam	ML, CL-ML	A-4	0	100	100	95-100	80-100	20-30	NP-10
	41-60	Silt loam	ML	A-4	0	100	100	95-100	80-100	20-30	NP-5
35*.											
Riverwash											
36F*:											
Rock outcrop.											
Rubble land.											
37D	0-3	Very cobbly loam	GM, SM	A-2, A-4	50-60	50-75	40-70	35-65	25-50	25-30	NP-5
Rockly	3-7	Very cobbly clay loam, very gravelly loam.	GM	A-2, A-6	5-60	20-60	25-55	25-50	20-40	35-40	10-15
	7	Unweathered bedrock.									

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
38A, 38B, 38C------	0-8	Silt loam-------	ML	A-4	0-5	95-100	90-95	80-90	65-80	20-30	NP-5
Roloff	8-24	Silt loam, very fine sandy loam.	ML	A-4	5-15	90-100	80-95	65-80	55-80	20-30	NP-5
	24	Unweathered bedrock.									
39D*:											
Roloff----------	0-8	Silt loam-------	ML	A-4	0-5	95-100	90-95	80-90	65-80	20-30	NP-5
	8-24	Silt loam, very fine sandy loam.	ML	A-4	5-15	90-100	80-95	65-80	55-80	20-30	NP-5
	24	Unweathered bedrock.									
Rock outcrop.											
40B, 40C, 40D, 40E, 41B, 41C----------	0-8	Fine sandy loam	ML, SM	A-4	0-5	95-100	95-100	80-95	45-60	15-25	NP-5
Sagehill	8-25	Very fine sandy loam, fine sandy loam, loamy very fine sand.	ML, SM	A-4	0-5	95-100	95-100	80-95	45-60	15-25	NP-5
	25-61	Stratified silt loam to fine sandy loam.	ML	A-4	0-5	95-100	95-100	80-95	50-90	15-25	NP-5
42B, 42C----------	0-20	Silt loam-------	ML	A-4	0	95-100	90-100	80-100	60-90	25-30	NP-5
Schrier	20-50	Loam, silt loam, clay loam.	ML	A-4	0	90-100	85-100	70-95	50-85	30-40	5-10
	50	Weathered bedrock.									
43E----------	0-11	Very stony silt loam.	ML	A-4, A-6	15-45	80-100	75-100	65-100	50-95	30-40	5-15
Simas	11-42	Clay, cobbly clay, gravelly silty clay loam.	CH, GC	A-7	0-45	70-100	65-100	50-100	40-95	50-70	25-40
	42-60	Gravelly clay, cobbly clay, very cobbly clay loam.	CH, GC	A-7	15-40	65-100	55-85	55-80	45-80	50-70	25-40
44----------	0-10	Fine sandy loam	SM	A-4	0	100	100	70-85	35-50	---	NP
Stanfield	10-21	Silt loam, very fine sandy loam.	ML	A-4	0	90-100	75-100	65-90	55-80	---	NP
	21	Indurated.									
45B----------	0-4	Loamy fine sand	SM	A-2, A-4	0	95-100	90-100	80-90	30-45	---	NP
Taunton	4-21	Fine sandy loam, very fine sandy loam.	SM, ML	A-4	0	95-100	90-100	80-95	40-60	15-25	NP-5
	21	Indurated.									
46C----------	0-7	Gravelly clay loam.	CL, SC	A-7	0-10	80-95	60-75	55-65	45-55	40-50	15-25
Tub	7-29	Cobbly clay-----	CH	A-7	0-25	80-95	65-80	55-75	50-70	50-70	25-40
	29-60	Silty clay loam	CH	A-7	0-5	80-95	75-90	65-80	60-75	50-60	25-35
46E----------	0-7	Stony silty clay loam.	CL, SC	A-7	10-25	80-95	60-85	55-65	45-55	40-50	15-25
Tub	7-29	Cobbly clay-----	CH	A-7	20-25	80-95	65-80	55-75	50-70	50-70	25-40
	29-60	Silty clay loam	CH	A-7	0-5	80-95	75-90	65-80	60-75	50-60	25-35

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
47C, 47E---------- Ukiah	0-10	Cobbly silty clay loam.	ML	A-7	25-40	80-100	75-100	70-100	65-95	40-50	10-15
	10-20	Cobbly clay, cobbly silty clay.	CH	A-7	15-35	80-100	70-85	60-80	50-70	50-60	25-35
	20-28	Clay loam, silty clay loam, gravelly loam.	CL-ML, CL	A-6	0-10	80-100	70-90	65-75	50-70	25-40	5-15
	28	Weathered bedrock.									
48B, 49D, 49E, 50D- Waha	0-12	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	90-95	20-30	NP-10
	12-26	Silty clay loam, silt loam.	CL	A-6	0	100	95-100	95-100	85-95	30-40	10-20
	26-32	Very gravelly clay loam, very cobbly silt loam.	GC	A-2	30-40	25-35	15-35	15-30	15-25	30-40	10-20
	32	Unweathered bedrock.									
51D*: Waha----------	0-12	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	90-95	20-30	NP-10
	12-26	Silty clay loam, silt loam.	CL	A-6	0	100	95-100	95-100	85-95	30-40	10-20
	26-32	Very gravelly clay loam, very cobbly silt loam.	GC	A-2	30-40	25-35	15-35	15-30	15-25	30-40	10-20
	32	Unweathered bedrock.									
Rockly----------	0-3	Very cobbly loam	GM, SM	A-2, A-4	50-60	50-75	40-70	35-65	25-50	25-30	NP-5
	3-7	Very cobbly clay loam, very gravelly loam.	GM	A-2, A-6	5-60	20-60	25-55	25-50	20-40	35-40	10-15
	7	Unweathered bedrock.									
52B, 52C, 53D, 53E, 54D, 54E---------- Walla Walla	0-17	Silt loam--------	ML	A-4	0	100	100	95-100	70-100	20-30	NP-5
	17-44	Silt loam--------	ML	A-4	0	100	100	95-100	80-100	20-35	NP-10
	44-67	Silt loam--------	ML	A-4	0	100	100	95-100	80-100	20-25	NP-5
55B, 55C, 55D, 55E- Warden	0-3	Silt loam--------	ML	A-4	0	95-100	95-100	85-100	70-90	25-30	NP-5
	3-30	Very fine sandy loam, silt loam.	ML	A-4	0	95-100	95-100	85-100	70-90	25-30	NP-5
	30-60	Silt loam, very fine sandy loam.	ML	A-4	0	95-100	95-100	85-100	70-90	25-30	NP-5
56B, 56C, 56D, 56E- Willis	0-19	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
	19-26	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
	26-60	Indurated.									
57F*: Wrentham----------	0-18	Silt loam--------	ML	A-4	0-10	90-100	85-100	85-100	75-90	30-35	NP-5
	18-33	Very cobbly silt loam, very gravelly silt loam, very cobbly silty clay loam.	GM, ML	A-2, A-4	20-65	35-90	25-85	20-85	20-75	30-35	NP-5
	33	Unweathered bedrock.									
Rock outcrop.											

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
58*. Xeric Torrifluvents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
1D	0-6	15-25	1.25-1.35	0.2-0.6	0.06-0.14	6.1-7.3	Low	0.15	1	---	---
Bakeoven	6-10	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Moderate	0.20			
	10	---	---	---	---	---					
2D*:											
Bakeoven	0-6	15-25	1.25-1.35	0.2-0.6	0.06-0.14	6.1-7.3	Low	0.15	1	---	---
	6-10	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Moderate	0.20			
	10	---	---	---	---	---					
Condon	0-31	15-20	1.25-1.35	0.6-2.0	0.19-0.21	6.1-7.3	Moderate	0.43	2	---	---
	31	18-24	1.30-1.40	---	---	---					
3D*:											
Bakeoven	0-6	15-25	1.25-1.35	0.2-0.6	0.06-0.14	6.1-7.3	Low	0.15	1	---	---
	6-10	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Moderate	0.20			
	10	---	---	---	---	---					
Morrow	0-9	18-25	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	Low	0.37	2	---	1-2
	9-13	27-35	1.30-1.40	0.2-0.6	0.19-0.21	6.6-7.8	Moderate	0.43			
	13-38	18-30	1.30-1.50	0.6-2.0	0.19-0.21	7.9-8.4	Low	0.43			
	38	---	---	---	---	---					
4C	0-7	15-22	1.30-1.40	0.6-2.0	0.16-0.18	6.6-7.3	Low	0.43	1	---	---
Blalock	7-18	18-25	1.35-1.45	0.6-2.0	0.12-0.18	6.6-7.8	Low	0.32			
	18-22	---	---	---	---	---					
	22-41	18-25	1.35-1.45	0.6-2.0	0.10-0.14	>7.8	Low	0.32			
	41	---	---	---	---	---					
5B*, 5C*, 6D*, 6E*, 7D*, 7E*:											
Condon	0-31	15-24	1.25-1.35	0.6-2.0	0.19-0.21	6.1-7.3	Moderate	0.43	2	---	---
	31	---	---	---	---	---					
Valby	0-9	15-20	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.8	Low	0.43	2	---	<2
	9-36	18-24	1.30-1.40	0.6-2.0	0.19-0.21	6.6-8.4	Low	0.49			
	36	---	---	---	---	---					
8*.											
Dune land											
9E	0-6	18-27	1.15-1.35	0.6-2.0	0.06-0.11	6.6-7.8	Low	0.20	1	---	---
Gwinly	6-10	27-40	1.15-1.35	0.2-0.6	0.06-0.11	6.6-7.3	Moderate	0.24			
	10-14	40-50	1.20-1.30	0.06-0.2	0.05-0.10	6.6-7.3	High	0.17			
	14	---	---	---	---	---					
10F*:											
Gwinly	0-6	18-27	1.15-1.35	0.6-2.0	0.06-0.11	6.6-7.8	Low	0.20	1	---	---
	6-10	27-40	1.15-1.35	0.2-0.6	0.06-0.11	6.6-7.3	Moderate	0.24			
	10-14	40-50	1.20-1.30	0.06-0.2	0.05-0.10	6.6-7.3	High	0.17			
	14	---	---	---	---	---					
Rock outcrop.											
11	0-31	10-18	1.25-1.35	0.6-2.0	0.19-0.21	6.6-8.4	Low	0.37	5	5	---
Hermiston	31-60	10-18	1.30-1.50	0.6-2.0	0.17-0.21	7.9-9.0	Low	0.49			
12F	0-23	15-25	1.15-1.25	0.6-2.0	0.13-0.20	6.6-7.3	Low	0.37	3	---	---
Kahler	23-50	20-27	1.20-1.30	0.6-2.0	0.13-0.20	6.6-7.3	Low	0.43			
	50	---	---	---	---	---					

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
13----------	0-13	10-18	1.25-1.35	2.0-6.0	0.11-0.17	6.6-7.8	Low----------	----	---	---	1-2
Kimberly	13-60	10-18	1.30-1.40	2.0-6.0	0.11-0.15	6.6-9.0	Low----------	----			
14B, 14D, 14E----	0-5	20-27	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	Low----------	0.32	4	---	---
Krebs	5-17	30-40	1.30-1.40	0.2-0.6	0.19-0.21	6.6-7.3	Moderate-----	0.37			
	17-27	40-50	1.40-1.60	0.06-0.2	0.15-0.21	6.6-7.8	High---------	0.37			
	27-48	30-40	1.40-1.60	0.2-0.6	0.19-0.21	7.9-8.4	Moderate-----	0.37			
	48	---	---	---	---	---	----------	----			
15E----------	0-3	15-25	1.25-1.35	0.6-2.0	0.08-0.14	6.1-7.3	Low----------	0.17	1	---	---
Lickskillet	3-15	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-7.3	Low----------	0.24			
	15	---	---	---	---	---	----------	----			
16F*:											
Lickskillet-----	0-3	15-25	1.25-1.35	0.6-2.0	0.08-0.14	6.1-7.3	Low----------	0.17	1	---	---
	3-15	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-7.3	Low----------	0.24			
	15	---	---	---	---	---	----------	----			
Rock outcrop.											
17B, 17C, 17D, 17E----------	0-16	8-12	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.8	Low----------	0.43	2	---	1-2
Mikkalo	16-38	8-12	1.30-1.40	0.6-2.0	0.18-0.20	7.4-8.4	Low----------	0.49			
	38	---	---	---	---	---	----------	----			
18B, 18C, 19D, 19E, 20D--------	0-9	18-25	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	Low----------	0.37	2	---	1-2
Morrow	9-20	27-35	1.30-1.40	0.2-0.6	0.19-0.21	6.6-7.8	Moderate-----	0.43			
	20-38	18-30	1.30-1.50	0.6-2.0	0.19-0.21	7.9-8.4	Low----------	0.43			
	38	---	---	---	---	---	----------	----			
21E*:											
Morrow----------	0-9	18-25	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	Low----------	0.37	2	---	1-2
	9-20	27-35	1.30-1.40	0.2-0.6	0.19-0.21	6.6-7.8	Moderate-----	0.43			
	20-38	18-30	1.30-1.50	0.6-2.0	0.19-0.21	7.9-8.4	Low----------	0.43			
	38	---	---	---	---	---	----------	----			
Lickskillet-----	0-3	15-25	1.25-1.35	0.6-2.0	0.08-0.14	6.1-7.3	Low----------	0.17	1	---	---
	3-15	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-7.3	Low----------	0.24			
	15	---	---	---	---	---	----------	----			
22F----------	0-21	10-18	1.25-1.35	0.6-2.0	0.16-0.19	6.6-7.3	Low----------	0.43	3	---	---
Nansene	21-60	10-18	1.30-1.40	0.6-2.0	0.16-0.19	6.6-7.8	Low----------	0.55			
23B, 23C, 23D----	0-12	15-18	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	Low----------	0.49	2	5	---
Olex	12-24	15-18	1.40-1.50	0.6-2.0	0.06-0.12	6.6-7.3	Low----------	0.24			
	24-60	15-18	1.40-1.50	0.6-2.0	0.06-0.12	7.4-8.4	Low----------	0.24			
24D, 24E---------	0-12	15-18	1.25-1.35	0.6-2.0	0.14-0.19	6.6-7.3	Low----------	0.37	---	---	---
Olex	12-24	15-18	1.40-1.50	0.6-2.0	0.06-0.12	6.6-7.3	Low----------	0.24			
	24-60	15-18	1.40-1.50	0.6-2.0	0.06-0.12	7.4-8.4	Low----------	0.24			
25D*:											
Olex----------	0-12	15-18	1.25-1.35	0.6-2.0	0.14-0.19	6.6-7.3	Low----------	0.37	---	---	---
	12-24	15-18	1.40-1.50	0.6-2.0	0.06-0.12	6.6-7.3	Low----------	0.24			
	24-60	15-18	1.40-1.50	0.6-2.0	0.06-0.12	7.4-8.4	Low----------	0.24			
Roloff----------	0-8	15-18	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.8	Low----------	0.49	2	5	---
	8-24	15-18	1.40-1.50	0.6-2.0	0.19-0.21	6.6-9.0	Low----------	0.49			
	24	---	---	---	---	---	----------	----			
26----------	0-13	15-18	1.25-1.35	0.6-2.0	0.20-0.25	6.6-8.4	Low----------	0.37	5	---	---
Powder	13-60	15-18	1.40-1.50	0.6-2.0	0.18-0.25	6.6-8.4	Low----------	0.37			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
27B*:											
Prosser	0-3	5-12	---	0.6-2.0	0.16-0.23	6.6-8.4	Low	0.55	2	3	.5-1
	3-25	5-12	---	0.6-2.0	0.16-0.22	7.4-8.4	Low	0.55			
	25	---	---	---	---	---	---	---			
Rock outcrop.											
28B	0-14	0-4	1.40-1.60	6.0-20	0.06-0.09	6.1-8.4	Low	0.17	5	1	<.5-.8
Quincy	14-62	0-4	1.40-1.60	6.0-20	0.06-0.09	6.1-8.4	Low	0.17			
29D*:											
Quincy	0-14	0-4	1.40-1.60	6.0-20	0.06-0.09	6.1-8.4	Low	0.17	5	1	<.5-.8
	14-62	0-4	1.40-1.60	6.0-20	0.06-0.09	6.1-8.4	Low	0.17			
Rock outcrop.											
30B, 30C, 30D, 30E	0-17	18-24	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	Low	0.43	5	---	1-2
Rhea	17-61	18-24	1.30-1.50	0.6-2.0	0.19-0.21	6.6-9.0	Moderate	0.49			
31B, 31C, 31D, 31E	0-12	8-15	1.25-1.30	0.6-2.0	0.15-0.17	6.6-7.8	Low	0.49	5	4	1-2
Ritzville	12-41	8-15	1.30-1.35	0.6-2.0	0.17-0.20	6.6-8.4	Low	0.55			
	41-60	8-15	1.35-1.40	0.6-2.0	0.17-0.20	7.9-9.0	Low	0.55			
32A, 32B, 32C, 32D, 33E, 34E	0-12	8-15	1.25-1.30	0.6-2.0	0.17-0.20	6.6-7.8	Low	0.49	5	5	1-2
Ritzville	12-41	8-15	1.30-1.35	0.6-2.0	0.17-0.20	6.6-8.4	Low	0.55			
	41-60	8-15	1.35-1.40	0.6-2.0	0.17-0.20	7.9-9.0	Low	0.55			
35*.											
Riverwash											
36F*:											
Rock outcrop.											
Rubble land.											
37D	0-3	20-27	1.25-1.35	0.6-2.0	0.06-0.11	6.1-7.3	Low	0.10	1	---	---
Rockly	3-7	20-30	1.30-1.40	0.2-0.6	0.06-0.11	6.1-7.3	Low	0.10			
	7	---	---	---	---	---	---	---			
38A, 38B, 38C	0-8	8-15	---	0.6-2.0	0.19-0.21	6.6-7.8	Low	0.49	2	5	---
Roloff	8-24	8-15	---	0.6-2.0	0.19-0.21	6.6-9.0	Low	0.49			
	24	---	---	---	---	---	---	---			
39D*:											
Roloff	0-8	8-15	---	0.6-2.0	0.19-0.21	6.6-7.8	Low	0.49	2	5	---
	8-24	8-15	---	0.6-2.0	0.19-0.21	6.6-9.0	Low	0.49			
	24	---	---	---	---	---	---	---			
Rock outcrop.											
40B, 40C, 40D, 40E, 41B, 41C	0-8	2-8	1.30-1.40	2.0-6.0	0.13-0.21	6.6-8.4	Low	0.43	5	3	<.5
Sagehill	8-25	2-8	1.30-1.60	2.0-6.0	0.13-0.20	6.6-8.4	Low	0.49			
	25-61	2-8	1.30-1.60	0.6-2.0	0.19-0.21	7.9-9.0	Low	0.55			
42B, 42C	0-20	15-25	1.25-1.35	0.6-2.0	0.17-0.21	6.6-7.8	Low	0.37	4	---	1-3
Schrier	20-50	20-30	1.30-1.40	0.6-2.0	0.14-0.18	7.4-8.4	Low	0.32			
	50	---	---	---	---	---	---	---			
43E	0-11	22-27	1.25-1.35	0.2-0.6	0.10-0.16	6.6-7.3	Moderate	0.20	4	---	---
Simas	11-42	35-50	1.15-1.25	0.06-0.2	0.09-0.16	7.4-8.4	High	0.20			
	42-60	35-60	1.15-1.35	0.06-0.2	0.09-0.13	7.9-9.0	High	0.20			
44	0-10	8-12	1.25-1.35	2.0-6.0	0.13-0.17	>7.9	Low	0.43	2	4L	---
Stanfield	10-21	10-18	1.30-1.50	0.6-2.0	0.19-0.21	>7.9	Low	0.49			
	21	---	---	---	---		---	---			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
45B----------	0-4	3-5	1.50-1.60	2.0-6.0	0.09-0.12	7.4-8.4	Low----------	0.37	2	2	<1
Taunton	4-21	5-8	1.40-1.55	2.0-6.0	0.14-0.16	7.4-9.0	Low----------	---			
	21	---	---	---	---	---	----------	---			
46C, 46E---------	0-7	27-35	---	0.2-0.6	0.17-0.19	6.6-7.3	Moderate-----	0.28	2	---	---
Tub	7-29	40-60	---	0.06-0.2	0.12-0.14	6.6-7.8	High---------	0.20			
	29-60	27-35	---	0.2-0.6	0.17-0.19	7.4-8.4	High---------	0.28			
47C, 47E---------	0-10	30-35	---	0.06-0.2	0.16-0.18	6.6-7.3	Moderate-----	0.25	2	---	---
Ukiah	10-20	50-60	---	<0.06	0.09-0.14	6.6-7.3	High---------	0.28			
	20-28	25-35	---	0.2-0.6	0.14-0.21	6.6-8.4	Moderate-----	0.32			
	28	---	---	---	---	---	----------	---			
48B, 49D, 49E,											
50D----------	0-12	10-15	---	0.6-2.0	0.18-0.21	6.1-6.5	Low----------	0.32	2	---	2-3
Waha	12-26	20-32	---	0.2-0.6	0.18-0.21	6.6-7.3	Moderate-----	0.37			
	26-32	25-35	---	0.2-0.6	0.06-0.09	6.6-7.3	Moderate-----	0.24			
	32	---	---	---	---	---	----------	---			
51D*:											
Waha----------	0-12	10-15	---	0.6-2.0	0.18-0.21	6.1-6.5	Low----------	0.32	2	---	2-3
	12-26	20-32	---	0.2-0.6	0.18-0.21	6.6-7.3	Moderate-----	0.37			
	26-32	25-35	---	0.2-0.6	0.06-0.09	6.6-7.3	Moderate-----	0.24			
	32	---	---	---	---	---	----------	---			
Rockly----------	0-3	20-27	1.25-1.35	0.6-2.0	0.06-0.11	6.1-7.3	Low----------	0.10	1	---	---
	3-7	20-30	1.30-1.40	0.2-0.6	0.06-0.11	6.1-7.3	Low----------	0.10			
	7	---	---	---	---	---	----------	---			
52B, 52C, 53D,											
53E, 54D, 54E---	0-17	10-18	---	0.6-2.0	0.17-0.20	6.1-7.8	Low----------	0.49	5	5	---
Walla Walla	17-44	10-18	---	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.55			
	44-67	10-18	---	0.6-2.0	0.16-0.19	7.9-9.0	Low----------	0.55			
55B, 55C, 55D,											
55E----------	0-3	8-15	1.30-1.40	0.6-2.0	0.19-0.21	6.6-7.8	Low----------	0.55	5	5	1-1.5
Warden	3-30	8-15	1.30-1.40	0.6-2.0	0.16-0.20	6.6-8.4	Low----------	0.55			
	30-60	8-15	1.35-1.45	0.6-2.0	0.19-0.21	7.9-9.0	Low----------	0.55			
56B, 56C, 56D,											
56E----------	0-19	10-15	---	0.6-2.0	0.19-0.21	6.6-7.8	Low----------	0.49	2	5	1-1.5
Willis	19-26	10-15	---	0.6-2.0	0.19-0.21	7.9-9.0	Low----------	0.55			
	26-60	---	---	<0.06	---	---	----------	---			
57F*:											
Wrentham--------	0-18	15-25	---	0.6-2.0	0.15-0.21	6.1-7.3	Low----------	0.37	2	---	---
	18-33	18-35	---	0.2-0.6	0.09-0.14	6.6-7.3	Low----------	0.20			
	33	---	---	---	---	---	----------	---			
Rock outcrop.											
58*.											
Xeric											
Torrifluvents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
					In		In				
1D---------- Bakeoven	D	None-------	---	---	5-12	Hard	---	---	Moderate	Moderate	Low.
2D*:											
Bakeoven----------	D	None-------	---	---	5-12	Hard	---	---	Moderate	Moderate	Low.
Condon----------	C	None-------	---	---	20-40	Hard	---	---	High-----	Moderate	Low.
3D*:											
Bakeoven----------	D	None-------	---	---	5-12	Hard	---	---	Moderate	Moderate	Low.
Morrow----------	C	None-------	---	---	20-40	Hard	---	---	High-----	High-----	Low.
4C---------- Blalock	D	None-------	---	---	40-60	Rippable	10-20	Rippable	Moderate	Moderate	Low.
5B*, 5C*, 6D*, 6E*, 7D*, 7E*:											
Condon----------	C	None-------	---	---	20-40	Hard	---	---	High-----	Moderate	Low.
Valby----------	C	None-------	---	---	20-40	Hard	---	---	High-----	Moderate	Low.
8*. Dune land											
9E---------- Gwinly	D	None-------	---	---	10-20	Hard	---	---	Moderate	Moderate	Low.
10F*:											
Gwinly----------	D	None-------	---	---	10-20	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.											
11---------- Hermiston	B	Rare-------	---	---	>60	---	---	---	Moderate	High-----	Low.
12F---------- Kahler	B	None-------	---	---	40-60	Hard	---	---	Moderate	Moderate	Low.
13---------- Kimberly	B	Rare-------	Brief-----	Dec-Mar	>60	---	---	---	Low------	Moderate	Low.
14B, 14D, 14E---------- Krebs	B	None-------	---	---	40-60	Rippable	---	---	Low------	Moderate	Low.
15E---------- Lickskillet	D	None-------	---	---	12-20	Hard	---	---	Moderate	Moderate	Low.
16F*:											
Lickskillet------	D	None-------	---	---	12-20	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.											
17B, 17C, 17D, 17E---------- Mikkalo	C	None-------	---	---	20-40	Hard	---	---	Moderate	Low------	Low.
18B, 18C, 19D, 19E, 20D---------- Morrow	C	None-------	---	---	20-40	Hard	---	---	High-----	High-----	Low.
21E*:											
Morrow----------	C	None-------	---	---	20-40	Hard	---	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
					In		In				
21E*: Lickskillet	D	None	---	---	12-20	Hard	---	---	Moderate	Moderate	Low.
22F---------- Nansene	B	None	---	---	>60	---	---	---	High	Moderate	Low.
23B, 23C, 23D, 24D, 24E---------- Olex	B	None	---	---	>60	---	---	---	Moderate	Moderate	Low.
25D*: Olex	B	None	---	---	>60	---	---	---	Moderate	Moderate	Low.
Roloff	C	None	---	---	20-40	Hard	---	---	Moderate	Moderate	Low.
26---------- Powder	B	Rare	Brief	Dec-May	>60	---	---	---	High	High	Low.
27B*: Prosser	C	None	---	---	20-40	Hard	---	---	Moderate	High	Low.
Rock outcrop.											
28B---------- Quincy	A	None	---	---	>60	---	---	---	Low	Low	Low.
29D*: Quincy	A	None	---	---	>60	---	---	---	Low	Low	Low.
Rock outcrop.											
30B, 30C, 30D, 30E---------- Rhea	B	None	---	---	>60	---	---	---	High	Moderate	Low.
31B, 31C, 31D, 31E, 32A, 32B, 32C, 32D, 33E, 34E---------- Ritzville	B	None	---	---	>60	---	---	---	High	High	Low.
35*. Riverwash											
36F*: Rock outcrop.											
Rubble land.											
37D---------- Rockly	D	None	---	---	5-12	Hard	---	---	Moderate	Low	Low.
38A, 38B, 38C----- Roloff	C	None	---	---	20-40	Hard	---	---	Moderate	Moderate	Low.
39D*: Roloff	C	None	---	---	20-40	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.											
40B, 40C, 40D, 40E, 41B, 41C---- Sagehill	B	None	---	---	>60	---	---	---	Moderate	High	Low.
42B, 42C---------- Schrier	B	None	---	---	40-60	Rippable	---	---	Moderate	Moderate	Low.
43E---------- Simas	C	None	---	---	>60	---	---	---	Low	High	Low.

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
					In		In				
44---------- Stanfield	C	None--------	---	---	>60	---	20-40	Ripable	Low------	High-----	Low.
45B---------- Taunton	C	None--------	---	---	>60	---	20-40	Hard	Moderate	High-----	Low.
46C, 46E---------- Tub	C	None--------	---	---	>40	Ripable	---	---	Moderate	High-----	Low.
47C, 47E---------- Ukiah	C	None--------	---	---	20-40	Ripable	---	---	Low------	High-----	Low.
48B, 49D, 49E, 50D---------- Waha	C	None--------	---	---	20-40	Hard	---	---	Moderate	Moderate	Low.
51D*: Waha----------	C	None--------	---	---	20-40	Hard	---	---	Moderate	Moderate	Low.
Rockly----------	D	None--------	---	---	5-12	Hard	---	---	Moderate	Low------	Low.
52B, 52C, 53D, 53E, 54D, 54E---- Walla Walla	B	None--------	---	---	>60	---	---	---	High-----	High-----	Low.
55B, 55C, 55D, 55E---------- Warden	B	None--------	---	---	>60	---	---	---	Moderate	High-----	Low.
56B, 56C, 56D, 56E---------- Willis	C	None--------	---	---	>60	Hard	20-40	Ripable	Moderate	High-----	Low.
57F*: Wrentham---------	C	None--------	---	---	20-40	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.											
58*---------- Xeric Torrifluvents	--	Rare--------	Very brief	Jan-Mar	>60	---	---	---	Low------	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bakeoven	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Blalock	Loamy, mixed, mesic, shallow Orthidic Durixerolls
Condon	Fine-silty, mixed, mesic Typic Haploxerolls
Gwinly	Clayey-skeletal, montmorillonitic, mesic Lithic Argixerolls
Hermiston	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Kahler	Fine-loamy, mixed, frigid Pachic Ultic Haploxerolls
Kimberly	Coarse-loamy, mixed, mesic Torrifluventic Haploxerolls
Krebs	Fine, montmorillonitic, mesic Aridic Calcic Argixerolls
Lickskillet	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Mikkalo	Coarse-silty, mixed, mesic Calciorthidic Haploxerolls
Morrow	Fine-silty, mixed, mesic Calcic Argixerolls
Nansene	Coarse-silty, mixed, mesic Pachic Haploxerolls
Olex	Loamy-skeletal, mixed, mesic Calciorthidic Haploxerolls
Powder	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Prosser	Coarse-loamy, mixed, mesic Xerollic Camborthids
Quincy	Mixed, mesic Xeric Torripsamments
Rhea	Fine-silty, mixed, mesic Calcic Haploxerolls
Ritzville	Coarse-silty, mixed, mesic Calciorthidic Haploxerolls
Rockly	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Roloff	Coarse-loamy, mixed, mesic Aridic Haploxerolls
Sagehill	Coarse-loamy, mixed, mesic Xerollic Camborthids
Schrier	Fine-loamy, mixed, mesic Calcic Pachic Haploxerolls
*Simas	Fine, montmorillonitic, mesic Aridic Palexerolls
Stanfield	Coarse-silty, mixed, mesic Xerollic Durorthids
Taunton	Coarse-loamy, mixed, mesic Xerollic Durorthids
*Tub	Fine, montmorillonitic, mesic Calcic Pachic Argixerolls
Ukiah	Fine, montmorillonitic, mesic Vertic Argixerolls
Valby	Fine-silty, mixed, mesic Calcic Haploxerolls
Waha	Fine-loamy, mixed, mesic Pachic Argixerolls
Walla Walla	Coarse-silty, mixed, mesic Typic Haploxerolls
Warden	Coarse-silty, mixed, mesic Xerollic Camborthids
Willis	Coarse-silty, mixed, mesic Orthidic Durixerolls
Wrentham	Loamy-skeletal, mixed, mesic Pachic Haploxerolls

*The Simas and Tub soils in Gilliam County are taxadjuncts to their respective series. See the series description of these soils for an explanation of the characteristics that are outside the range for the series.

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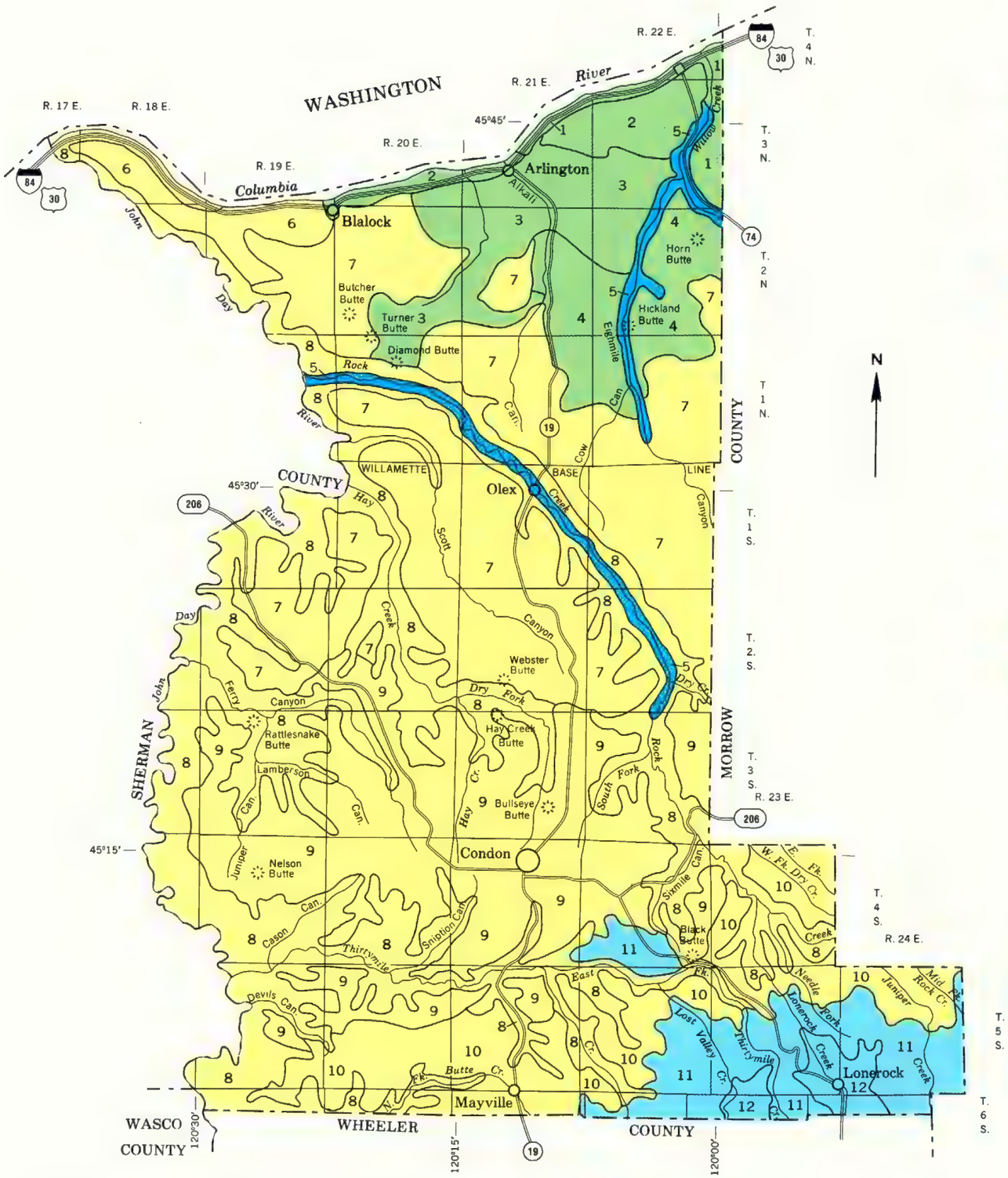


LEGEND

AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, WELL DRAINED AND EXCESSIVELY DRAINED SOILS FORMED IN EOLIAN SANDS, ALLUVIUM AND LACUSTRINE MATERIAL IN A 7 to 11 INCH PRECIPITATION ZONE.

1 — Quincy-Sagehill: Very deep, well drained and excessivley drained fine sandy loams and loamy fine sands

2 — Roloff: Moderately deep, well drained silt loams

3 — Olex-Krebs: Deep, well drained silt loams and gravelly silt loams

4 — Warden-Sagehill: Very deep, well drained fine sandy loams and silt loams

AREAS DOMINATED BY VERY DEEP, WELL DRAINED AND SOMEWHAT EXCESSIVELY DRAINED SOILS FORMED IN RECENT ALLUVIUM IN AN 8 TO 14 INCH PRECIPITATION ZONE.

5 — Xeric Torrifluvents-Kimberly: Very deep, well drained and somewhat excessively drained fine sandy loams

AREAS DOMINATED BY VERY SHALLOW TO VERY DEEP, WELL DRAINED SOILS FORMED IN LOESS AND COLLUVIUM IN A 9 TO 14 INCH PRECIPITATION ZONE.

6 — Walla Walla: Very deep, well drained silt loams

7 — Ritzville-Mikkalo: Moderately deep and very deep, well drained silt loams

8 — Lickskillet-Wrentham: Shallow and moderately deep well drained very gravelly silt loams and very stony loams

9 — Condon-Valby: Moderately deep, well drained silt loams

10 — Morrow-Bakeoven: Very shallow and moderately deep, well drained silt loams and very cobbly loams

AREAS DOMINATED BY VERY SHALLOW TO VERY DEEP, WELL DRAINED SOILS FORMED IN LOESS, COLLUVIUM AND RESIDUUM FROM BASALT, AND LACUSTRINE SEDIMENT IN A 14 TO 18 INCH PRECIPITATION ZONE.

11 — Waha-Gwinly-Rockly: Very shallow to moderately deep, well drained silt loams, very cobbly loams and very cobbly silt loams

12 — Tub-Simas-Ukiah: Moderately deep and very deep, well drained stony silt loams, cobbly silty clay loams and stony silty clay loams

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Compiled 1983

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OREGON AGRICULTURAL EXPERIMENT STATION

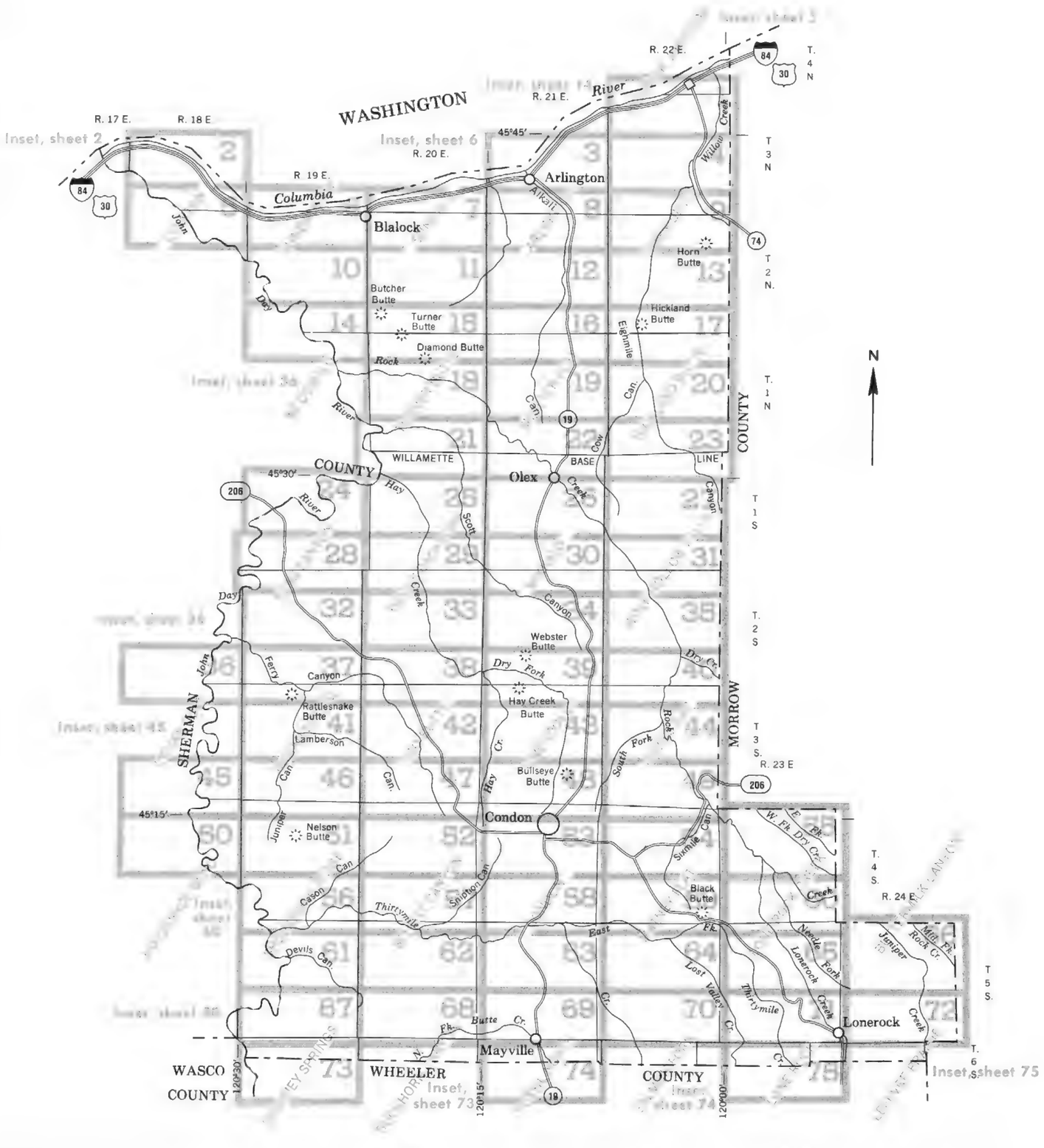
GENERAL SOIL MAP

GILLIAM COUNTY, OREGON

Scale 1:380,160

1 0 1 2 3 4 5 6 Miles

1 0 5 10 Km



N

INDEX TO MAP SHEETS
GILLIAM COUNTY, OREGON

Scale 1:380,160

1 0 1 2 3 4 5 6 Miles

1 0 5 10 Km

SOIL LEGEND

The symbol is a slightly modified numerical system. Arabic numerals indicate the soil name. The capital letters following the numerals indicate the slope class. Capital letters are omitted in symbols for soils which occur only on nearly level slopes and for miscellaneous areas that have a wide range in slope.

SYMBOL	NAME
1D	Bakeoven very cobbly loam, 2 to 20 percent slopes
2D	Bakeoven-Condon complex, 2 to 20 percent slopes
3D	Bakeoven-Morrow complex, 2 to 20 percent slopes
4C	Blalock loam, 2 to 12 percent slopes
5B	Condon and Valby silt loams, 1 to 7 percent slopes
5C	Condon and Valby silt loams, 7 to 12 percent slopes
6D	Condon and Valby silt loams, 12 to 20 percent north slopes
6E	Condon and Valby silt loams, 20 to 35 percent north slopes
7D	Condon and Valby silt loams, 12 to 20 percent south slopes
7E	Condon and Valby silt loams, 20 to 30 percent south slopes
8	Dune land*
9E	Gwinly very cobbly silt loam, 7 to 40 percent slopes
10F	Gwinly-Rock outcrop complex, 40 to 70 percent slopes
11	Hermiston silt loam
12F	Kahler silt loam, bedrock substratum, 35 to 70 percent slopes
13	Kimberly fine sandy loam
14B	Krebs silt loam, 2 to 5 percent slopes
14D	Krebs silt loam, 5 to 20 percent slopes
14E	Krebs silt loam, 20 to 40 percent slopes
15E	Lickskillet very stony loam, 7 to 40 percent slopes
16F	Lickskillet-Rock outcrop complex, 40 to 70 percent slopes
17B	Mikkalo silt loam, 2 to 7 percent slopes
17C	Mikkalo silt loam, 7 to 12 percent slopes
17D	Mikkalo silt loam, 12 to 20 percent slopes
17E	Mikkalo silt loam, 20 to 40 percent slopes
18B	Morrow silt loam, 1 to 7 percent slopes
18C	Morrow silt loam, 7 to 12 percent slopes
19D	Morrow silt loam, 12 to 20 percent north slopes
19E	Morrow silt loam, 20 to 35 percent north slopes
20D	Morrow silt loam, 12 to 20 percent south slopes
21E	Morrow-Lickskillet complex, 20 to 30 percent slopes
22F	Nansene silt loam, 35 to 70 percent slopes
23B	Olex silt loam, 0 to 5 percent slopes
23C	Olex silt loam, 5 to 12 percent slopes
23D	Olex silt loam, 12 to 20 percent slopes
24D	Olex gravelly silt loam, 5 to 20 percent slopes
24E	Olex gravelly silt loam, 20 to 40 percent slopes
25D	Olex-Roloff complex, 5 to 20 percent slopes
26	Powder silt loam
27B	Prosser-Rock outcrop complex, 1 to 5 percent slopes
28B	Quincy loamy fine sand, 0 to 5 percent slopes
29D	Quincy-Rock outcrop complex, 1 to 20 percent slopes
30B	Rhea silt loam, 1 to 7 percent slopes
30C	Rhea silt loam, 7 to 12 percent slopes
30D	Rhea silt loam, 12 to 20 percent slopes
30E	Rhea silt loam, 20 to 40 percent slopes
31B	Ritzville very fine sandy loam, 2 to 7 percent slopes
31C	Ritzville very fine sandy loam, 7 to 12 percent slopes
31D	Ritzville very fine sandy loam, 12 to 20 percent slopes
31E	Ritzville very fine sandy loam, 20 to 40 percent slopes
32A	Ritzville silt loam, 0 to 2 percent slopes
32B	Ritzville silt loam, 2 to 7 percent slopes
32C	Ritzville silt loam, 7 to 12 percent slopes
32D	Ritzville silt loam, 12 to 20 percent slopes
33E	Ritzville silt loam, 20 to 40 percent north slopes
34E	Ritzville silt loam, 20 to 40 percent south slopes
35	Riverwash*
36F	Rock outcrop-Rubble land complex, very steep*
37D	Rockly very cobbly loam, 2 to 20 percent slopes
38A	Roloff silt loam, 0 to 2 percent slopes
38B	Roloff silt loam, 2 to 7 percent slopes
38C	Roloff silt loam, 7 to 12 percent slopes
39D	Roloff-Rock outcrop complex, 1 to 20 percent slopes
40B	Sagehill fine sandy loam, 2 to 5 percent slopes
40C	Sagehill fine sandy loam, 5 to 12 percent slopes
40D	Sagehill fine sandy loam, 12 to 20 percent slopes
40E	Sagehill fine sandy loam, 20 to 40 percent slopes
41B	Sagehill fine sandy loam, hummocky, 2 to 5 percent slopes
41C	Sagehill fine sandy loam, hummocky, 5 to 12 percent slopes
42B	Schrier silt loam, shaly substratum, 2 to 7 percent slopes
42C	Schrier silt loam, shaly substratum, 7 to 12 percent slopes
43E	Simas very stony silt loam, 7 to 40 percent south slopes
44	Stanfield fine sandy loam
45B	Taunton loamy fine sand, 2 to 5 percent slopes
46C	Tub gravelly clay loam, 1 to 12 percent slopes
46E	Tub stony silty clay loam, 12 to 40 percent slopes
47C	Ukiah cobbly silty clay loam, 2 to 12 percent slopes
47E	Ukiah cobbly silty clay loam, 12 to 35 percent slopes
48B	Waha silt loam, 1 to 7 percent slopes
49D	Waha silt loam, 7 to 25 percent north slopes
49E	Waha silt loam, 25 to 40 percent north slopes
50D	Waha silt loam, 7 to 25 percent south slopes
51D	Waha-Rockly complex, 2 to 20 percent slopes
52B	Walla Walla silt loam, 1 to 7 percent slopes
52C	Walla Walla silt loam, 7 to 12 percent slopes
53D	Walla Walla silt loam, 12 to 20 percent north slopes
53E	Walla Walla silt loam, 20 to 35 percent north slopes
54D	Walla Walla silt loam, 12 to 20 percent south slopes
54E	Walla Walla silt loam 20 to 35 percent south slopes
55B	Warden silt loam 2 to 5 percent slopes
55C	Warden silt loam, 5 to 12 percent slopes
55D	Warden silt loam, 12 to 20 percent slopes
55E	Warden silt loam, 20 to 40 percent slopes
56B	Willis silt loam, 2 to 5 percent slopes
56C	Willis silt loam, 5 to 12 percent slopes
56D	Willis silt loam, 12 to 20 percent slopes
56E	Willis silt loam, 20 to 30 percent slopes
57F	Wrentham-Rock outcrop complex, 35 to 70 percent slopes
58	Xeric Torrifluvents, nearly level*

*Broadly defined

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline
- AD HOC BOUNDARY (label) — Hedley Airstrip
- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water, w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — CnB, WaC2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

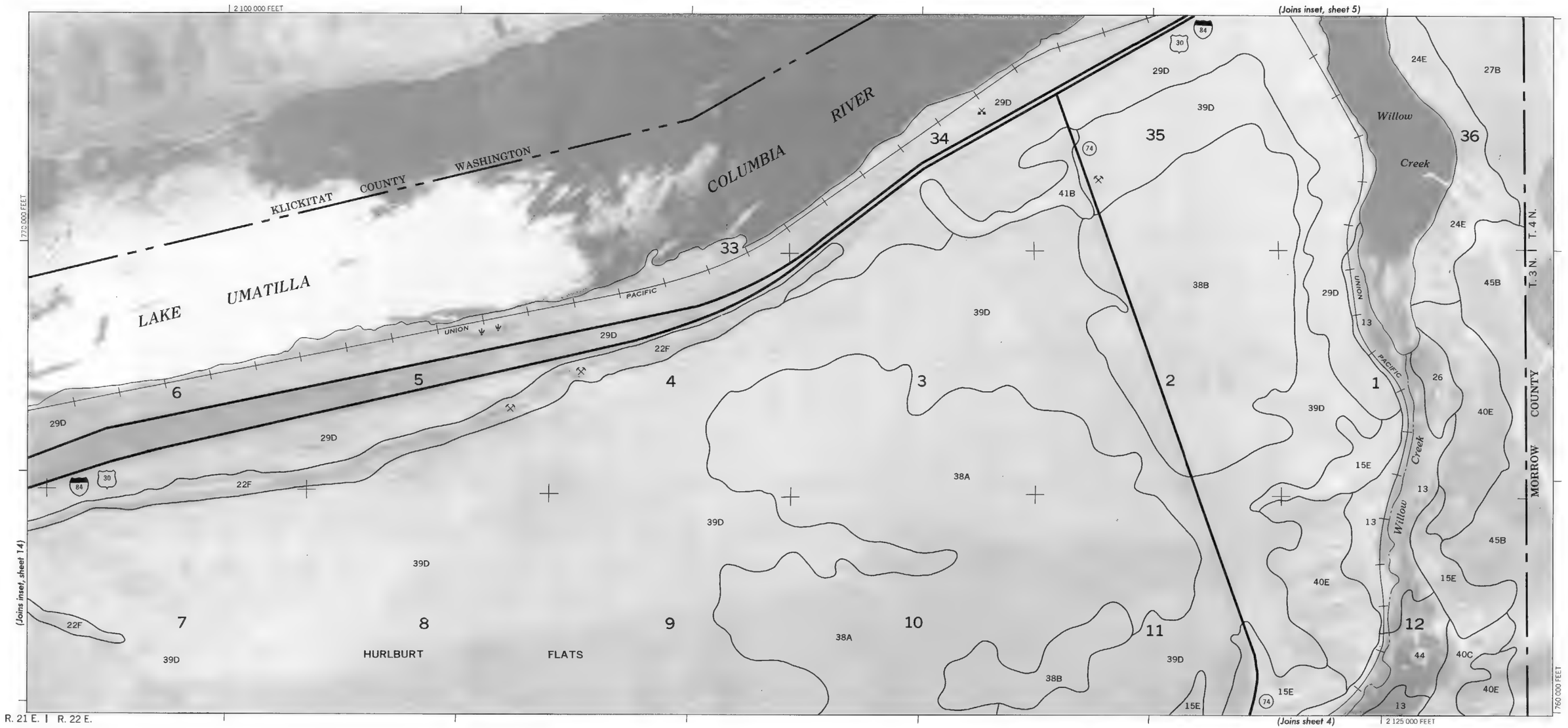
GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot — 0



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N

2

N

2 000 000 FEET

1 967 000 FEET

1 962 000 FEET

1 970 000 FEET

755 000 FEET

750 000 FEET

745 000 FEET

T. 3 N.

R. 17 E.

R. 18 E.

COLUMBIA RIVER

KLICKITAT COUNTY

WASHINGTON

KLICKITAT CO. WA.

LAKE UMATILLA

UMATILLA

SHERMAN COUNTY

JOHN DAY RIVER

LAKE JOHN DAY

PACIFIC UNION

THE NOOK

13 18 17 24 19 20 21 22 30 29 28 27 26

29D 36F 52C 52B 16F 54D 22F 55E 53D

(Joins inset)

(Joins sheet 2)

(Joins sheet 5)

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners - if shown, are approximately positioned.

Base maps are orthophotographs prepared by the U.S. Department of the Interior, Geological Survey, from 1977 aerial photography.

This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies.
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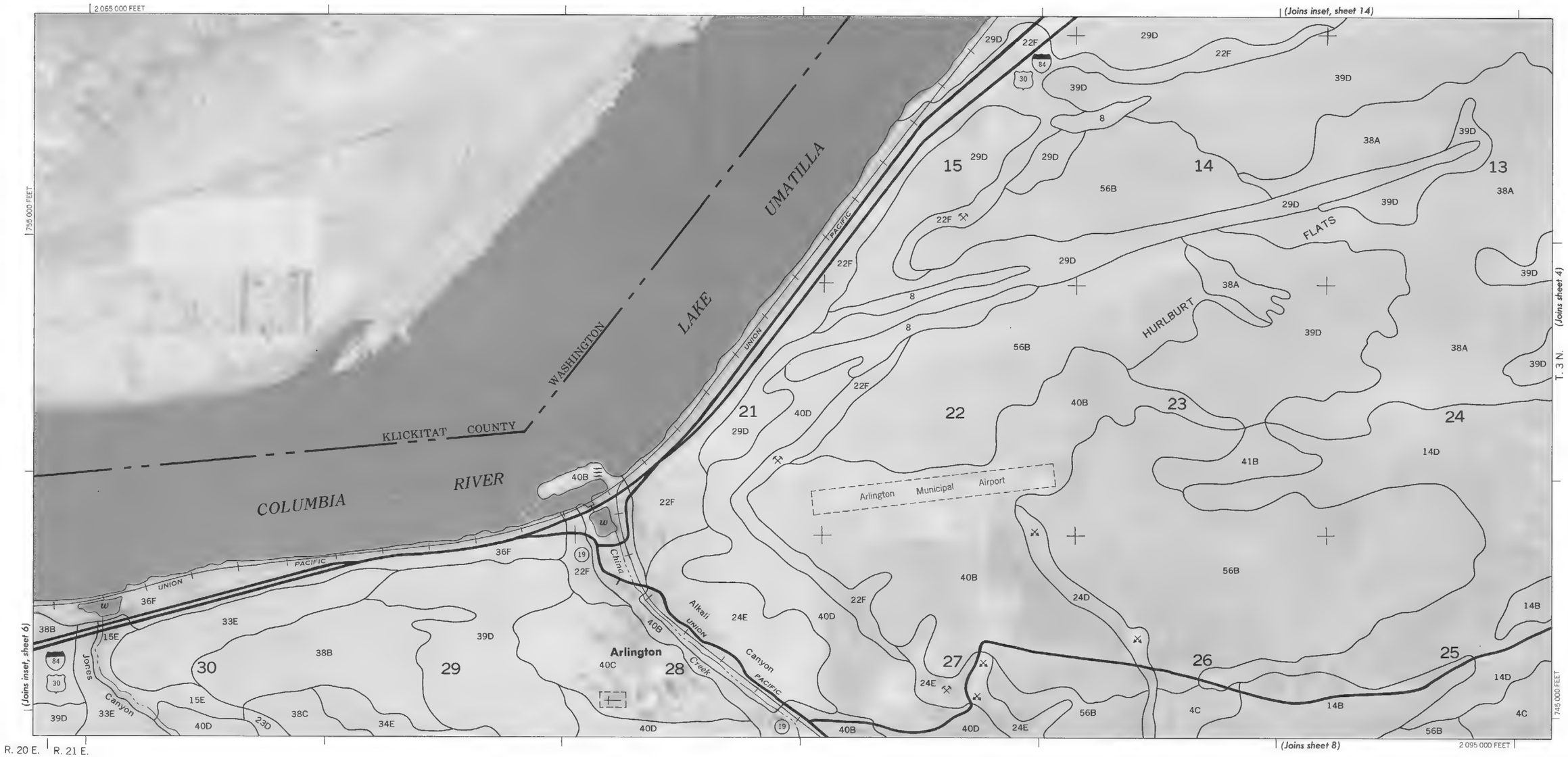

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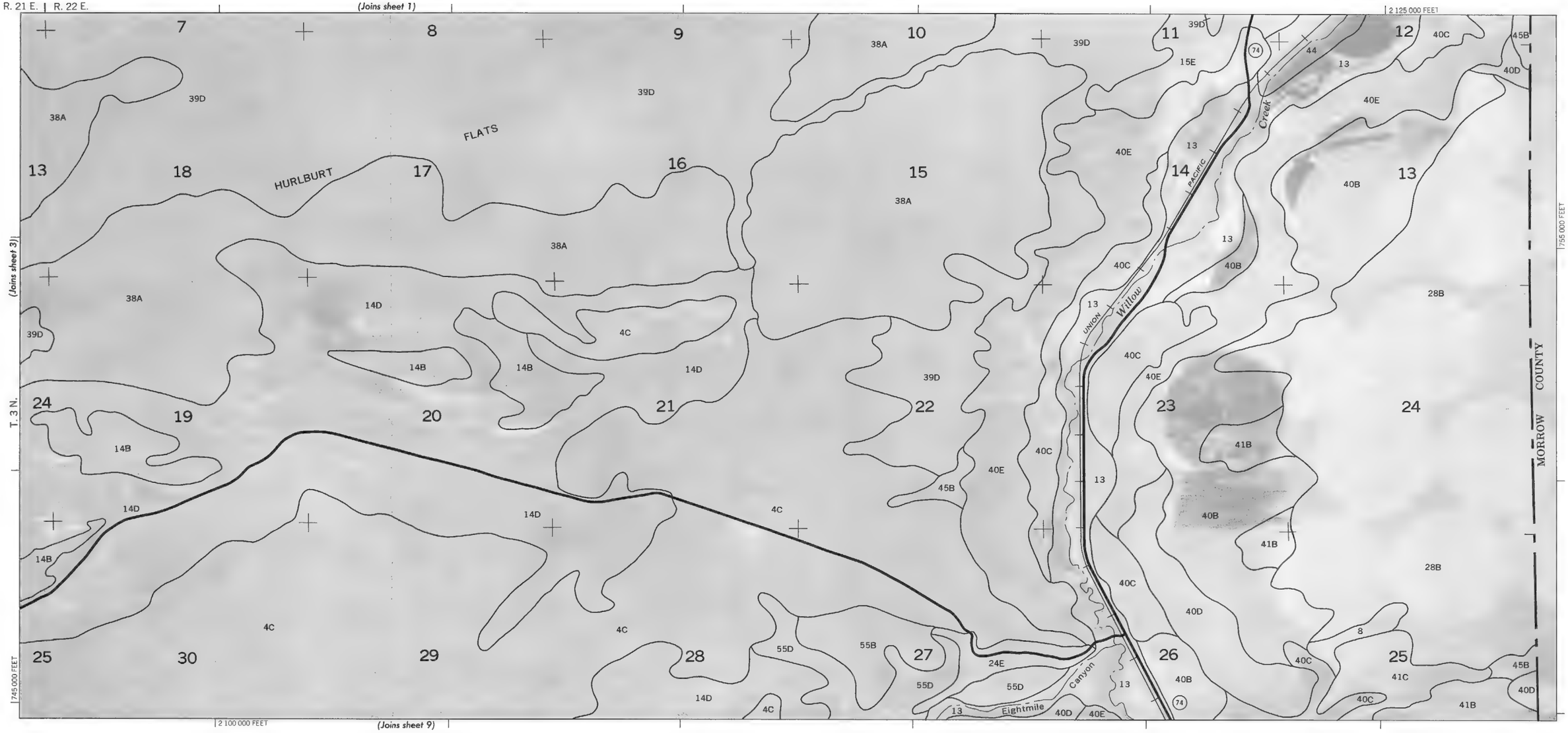
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000



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N

1 970 000 FEET

740 000 FEET

R. 18 E.

(Joins sheet 2)

T. 2 N. | T. 3 N.

2 120 000 FEET

781 000 FEET

T. 4 N.

775 000 FEET

R. 22 E.

(Joins sheet 1)

2 125 000 FEET

1 995 000 FEET

730 000 FEET

(Joins sheet 10) | (Joins sheet 6)

SHERMAN COUNTY

WASHINGTON COUNTY

KLICKITAT COUNTY

MORROW COUNTY

COLUMBIA RIVER

LAKE UMATILLA

JOHN DAY RIVER

THE NOOK

Willow Creek

PACIFIC UNION U.P.

32 33 34 35 36

4 3 2 1

26 25 27B 24E

10 11 12

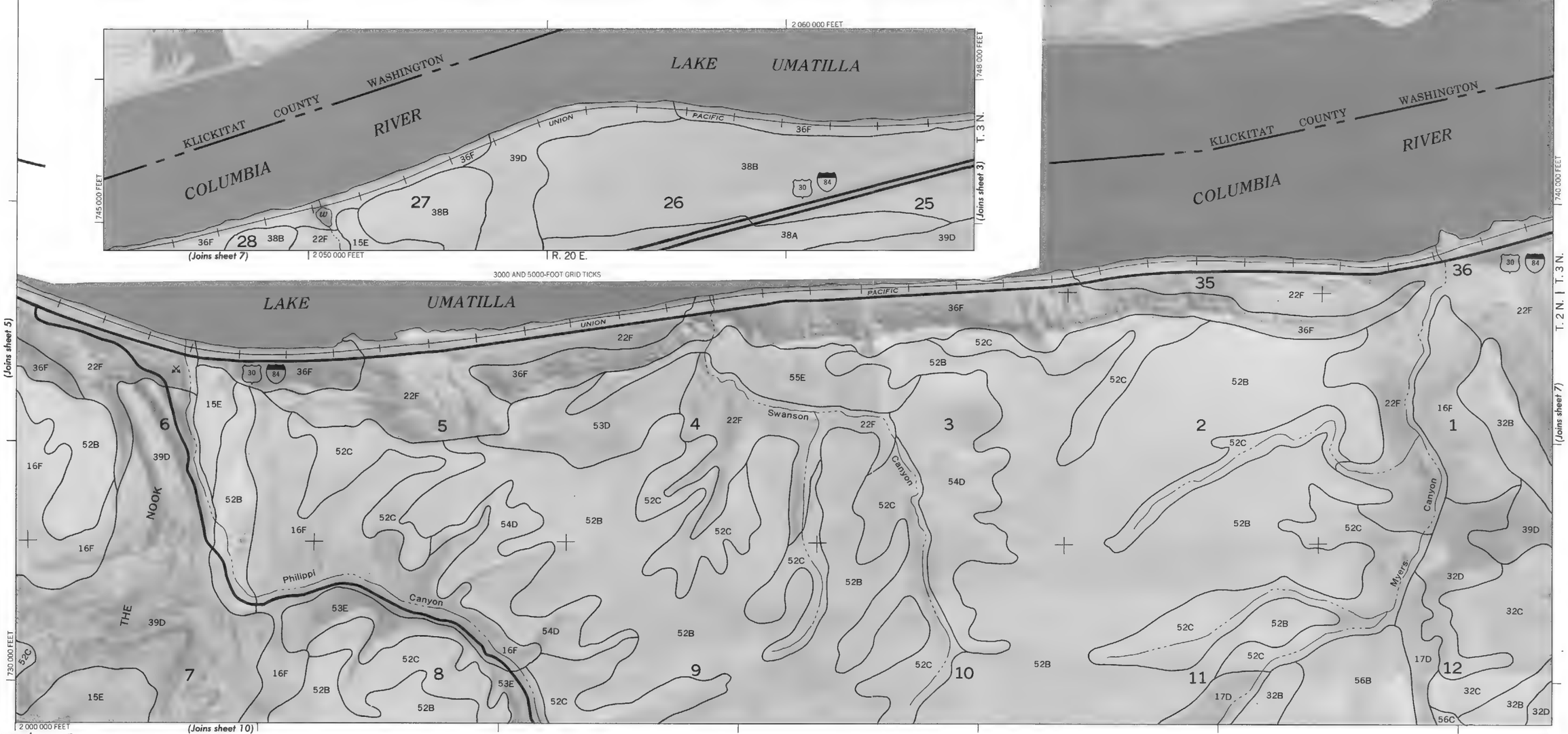
55E 16F 52C 52B 54D 22F 36F 53D 29D 39D 15E 55B

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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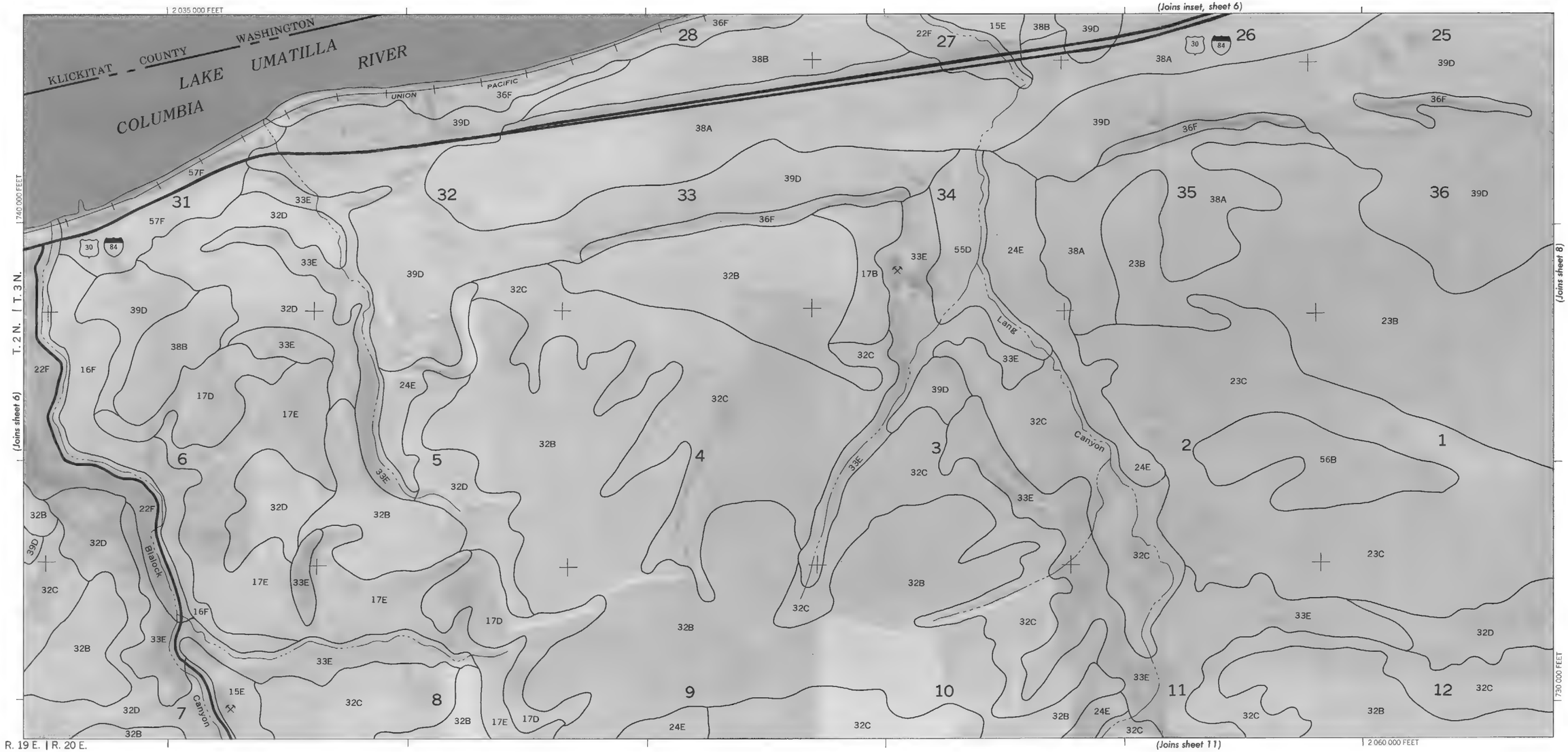
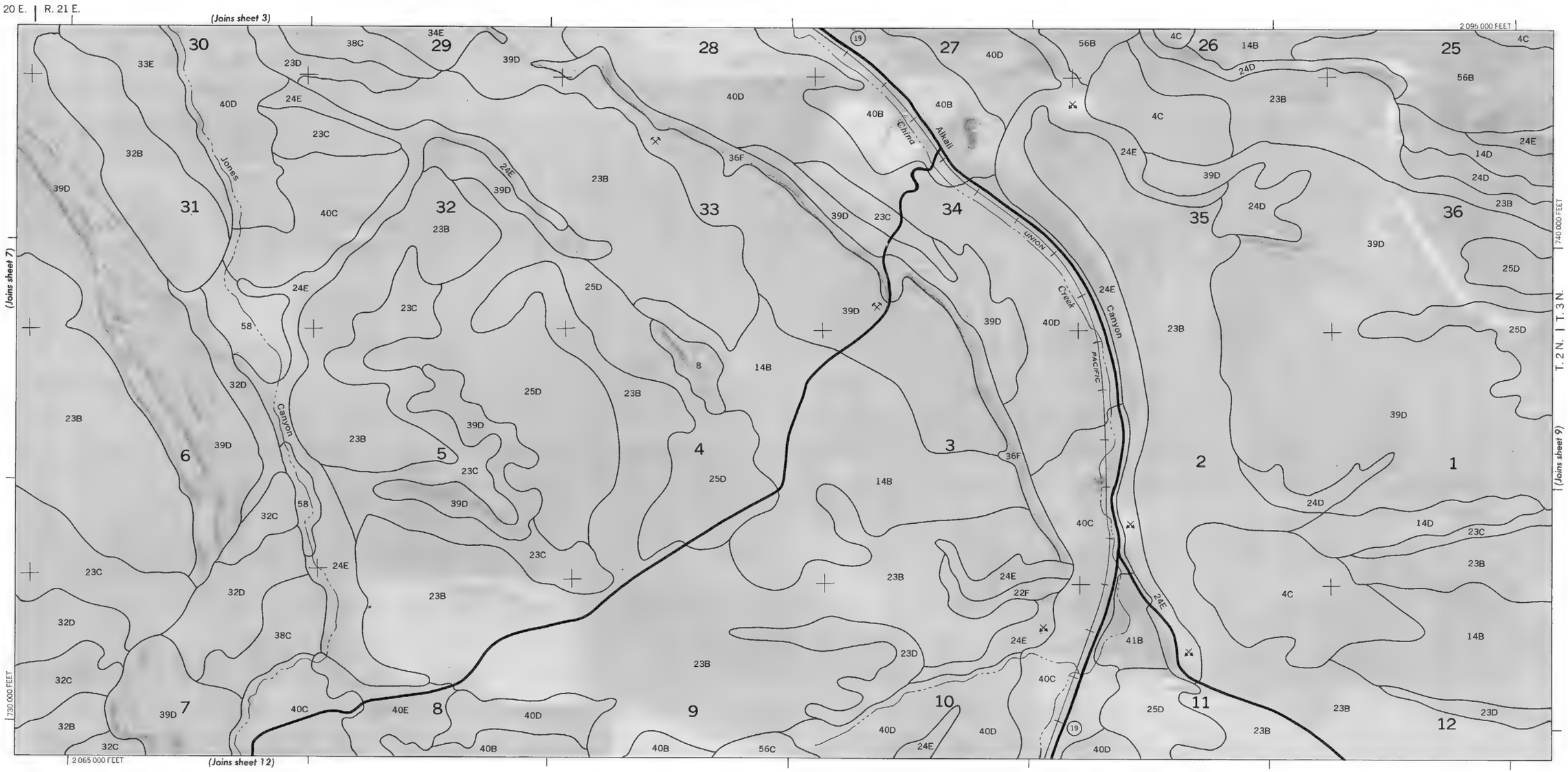


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet



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N

R. 21 E. | R. 22 E. | 2 100 000 FEET

(Joins sheet 4)

T. 2 N. | T. 3 N.

(Joins sheet 8)

| 740 000 FEET

MORROW COUNTY

| 730 000 FEET

(Joins sheet 13) | 2 125 000 FEET

Eightmile Canyon

Willow Creek

UNION PACIFIC

Horn Butte

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

(10)

N

R. 18 E. | R. 19 E.

(Joins sheet 6)

2 030 000 FEET

(Joins sheet 5)

725 000 FEET

T. 2 N.

(Joins sheet 11)

715 000 FEET

2 000 000 FEET

(Joins sheet 14)

Philippi Canyon

JOHN DAY RIVER

SHERMAN COUNTY

JOHN DAY RIVER

SHERMAN COUNTY

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

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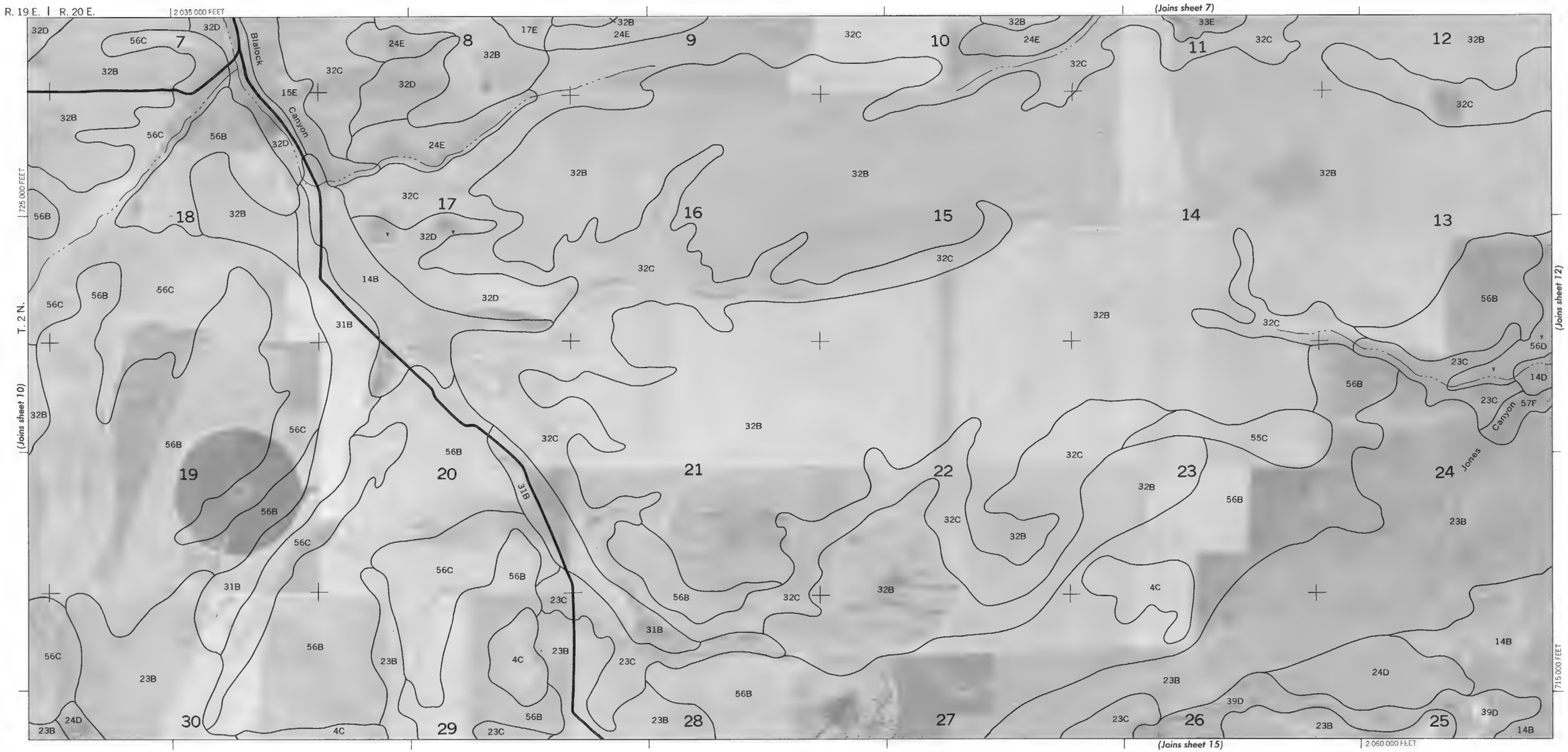

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

12

N

R. 20 E. | R. 21 E.

(Joins sheet 8)

2 095 000 FEET

725 000 FEET

T. 2 N.

(Joins sheet 13)

715 000 FEET

2 065 000 FEET

(Joins sheet 16)

(Joins sheet 11)

Jones Canyon

China Creek Canyon

Alkali Canyon

PACIFIC UNION

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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N

R. 21 E. | R. 22 E.

2 100 000 FEET

(Joins sheet 9)

T. 2 N.

725 000 FEET

(Joins sheet 12)

MORROW COUNTY

715 000 FEET

(Joins sheet 17)

2 125 000 FEET

Canyon

Eightmile

Fourmile

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

N

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N

R. 19 E. | R. 20 E.

2 035 000 FEET

(Joins sheet 11)

T. 1 N. | T. 2 N.

2 060 000 FEET

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 18)

710 000 FEET

700 000 FEET

Butcher Butte

Turner Butte

Diamond Butte

Canyon

Alkali

SHUTLER FLAT

PACIFIC UNION

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

16

N

R. 20 E. | R. 21 E.

(Joins sheet 12)

2 095 000 FEET

710 000 FEET

T. 1 N. | T. 2 N.

(Joins sheet 15)

(Joins sheet 17)

720 000 FEET

2 065 000 FEET

(Joins sheet 19)

Alkali Canyon

intermittent

PACIFIC UNION

SHUTLER FLAT

19

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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N

R. 21 E. | R. 22 E.

2 100 000 FEET

(Joins sheet 13)

T. 1 N. | T. 2 N. (Joins sheet 16)

1 710 000 FEET

Canyon

Eightmile

Hickland Butte

Fourmile

Canyon

COUNTY

MORROW

1 700 000 FEET

(Joins sheet 20)

2 125 000 FEET

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

(18)

N

R. 19 E. | R. 20 E.

(Joins sheet 15)

2 060 000 FEET

695 000 FEET

T. 1 N.

(Joins inset A, sheet 36)

(Joins sheet 19)

685 000 FEET

2 035 000 FEET

(Joins sheet 21)

Rock Creek

Rock Creek

UNION PACIFIC

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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N

R. 20 E. | R. 21 E.

2 065 000 FEET

T. 1 N.

695 000 FEET

(Joins sheet 18)

(Joins sheet 16)

(Joins sheet 20)

(Joins sheet 22)

685 000 FEET

2 095 000 FEET

SHUTLER FLAT

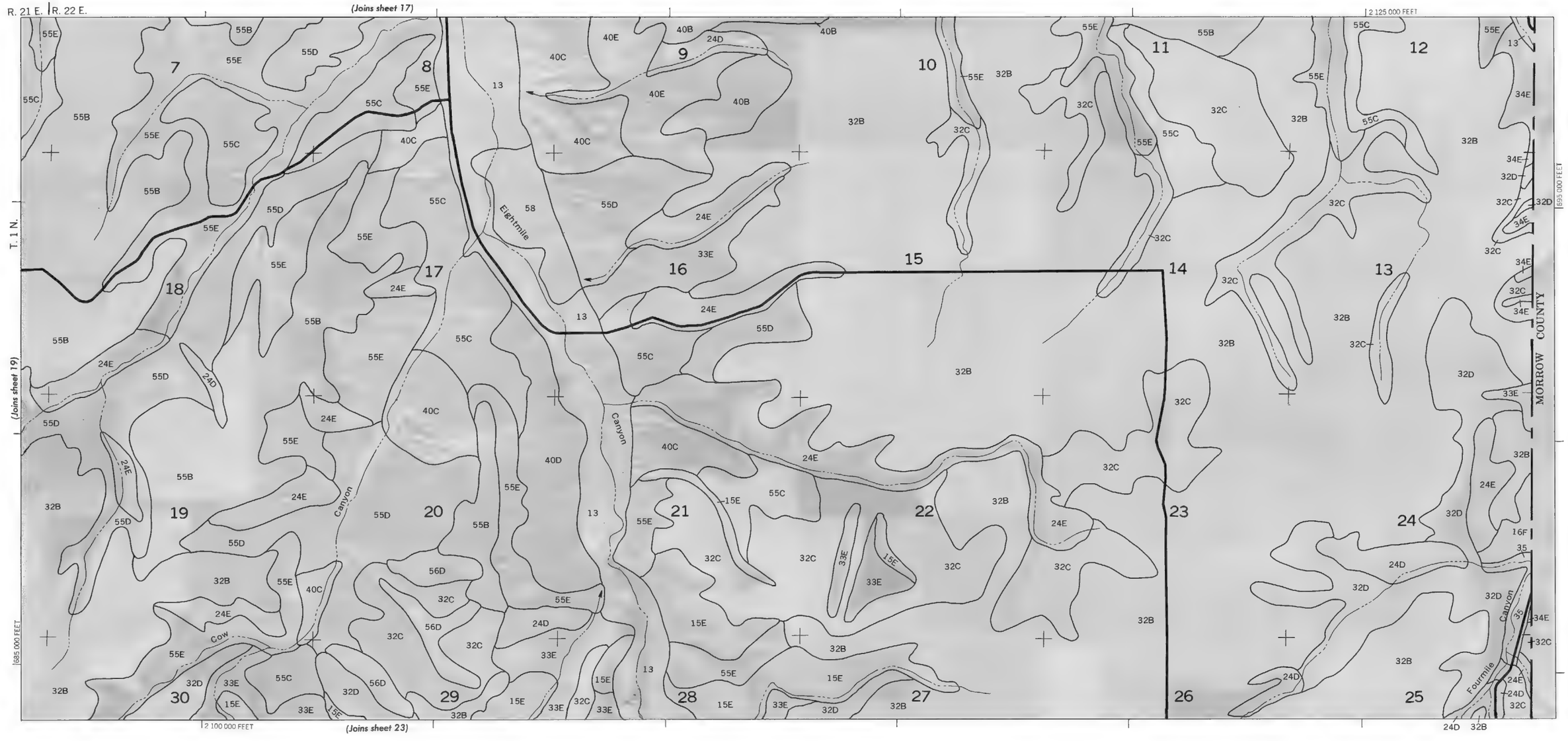
Rock Creek

7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25

32A 32B 32C 32D 24D 24E 15E 33E 34E 40E 55B 55C 55D 56B 56C 56D

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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N

(Joins inset A, sheet 36)

2 030 000 FEET

R. 19 E. | R. 20 E.

680 000 FEET

(Joins sheet 18)

(Joins sheet 22)

T. 1 S. | T. 1 N.

670 000 FEET

(Joins sheet 25)

2 060 000 FEET

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SHERMAN COUNTY

GILLIAM COUNTY

JOHN DAY RIVER

Scott Canyon

Hay Creek

UNION PACIFIC

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

22

N

R. 20 E. | R. 21 E.

(Joins sheet 19)

2 095 000 FEET

580 000 FEET

(Joins sheet 21)

(Joins sheet 23)

T. 1 S. | T. 1 N.

670 000 FEET

2 065 000 FEET

(Joins sheet 26)

R. 21 E. | R. 22 E.

Rock Creek

Charlie Canyon

French Creek

Rock Creek

Cow Canyon

UNION

UNION

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

Base maps are orthophotographs prepared by the U.S. Department of the Interior, Geological Survey, from 1977 aerial photography.

This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies.

N

R. 21 E. | R. 22 E.

2 100 000 FEET

(Joins sheet 20)

680 000 FEET

T. 1 S. | T. 1 N.

(Joins sheet 22)

MORROW COUNTY

570 000 FEET

(Joins sheet 27)

2 125 000 FEET

Canyon

Cow

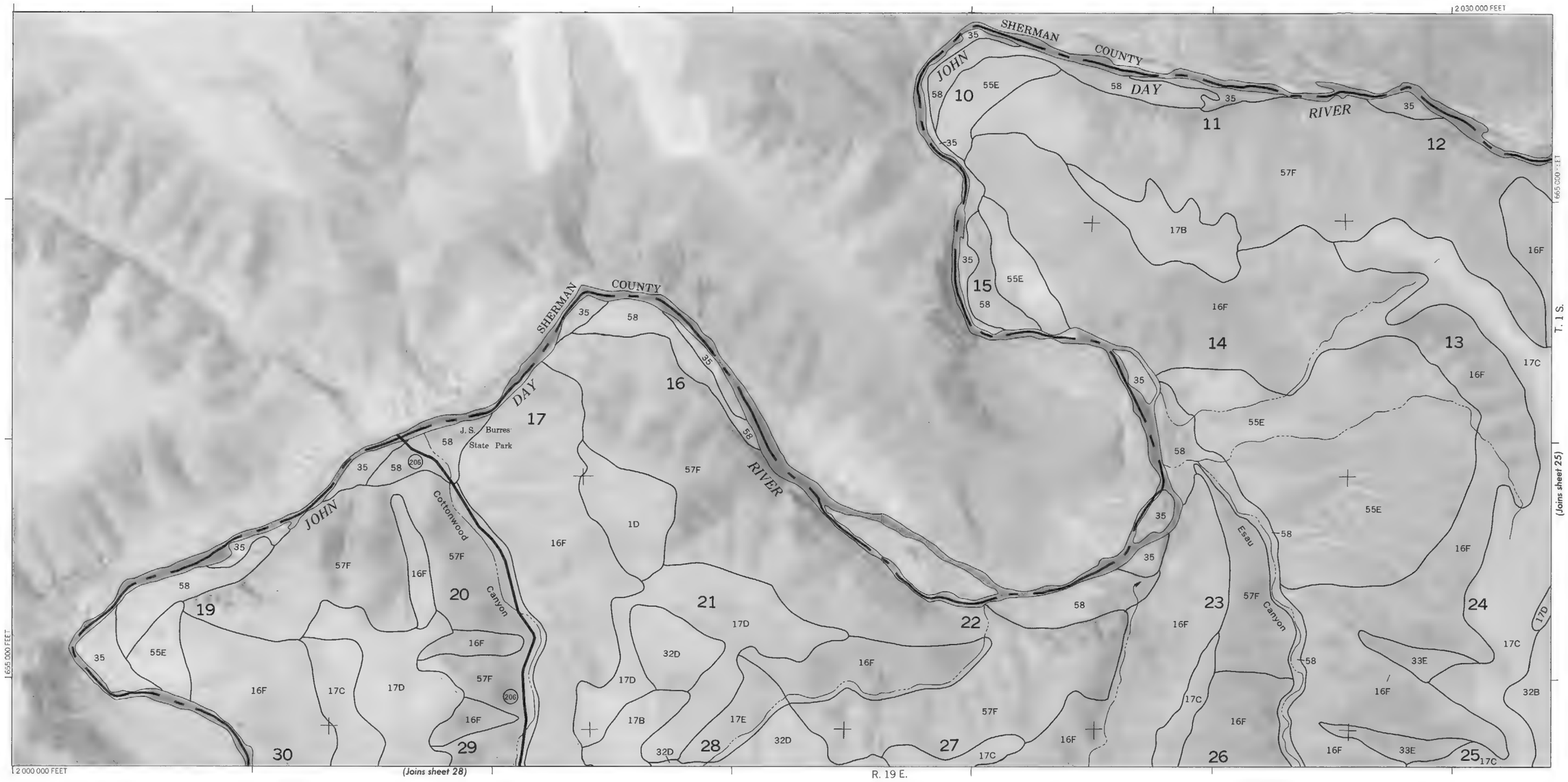
Eightmile

Fourmile

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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N

2 035 000 FEET

665 000 FEET

T. 1 S.

SHERMAN COUNTY

JOHN DAY RIVER

Hay Creek

Spring Creek

Hollow

Scott Canyon

Hay Creek

(Joins sheet 21)

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 29)

655 000 FEET

2 060 000 FEET

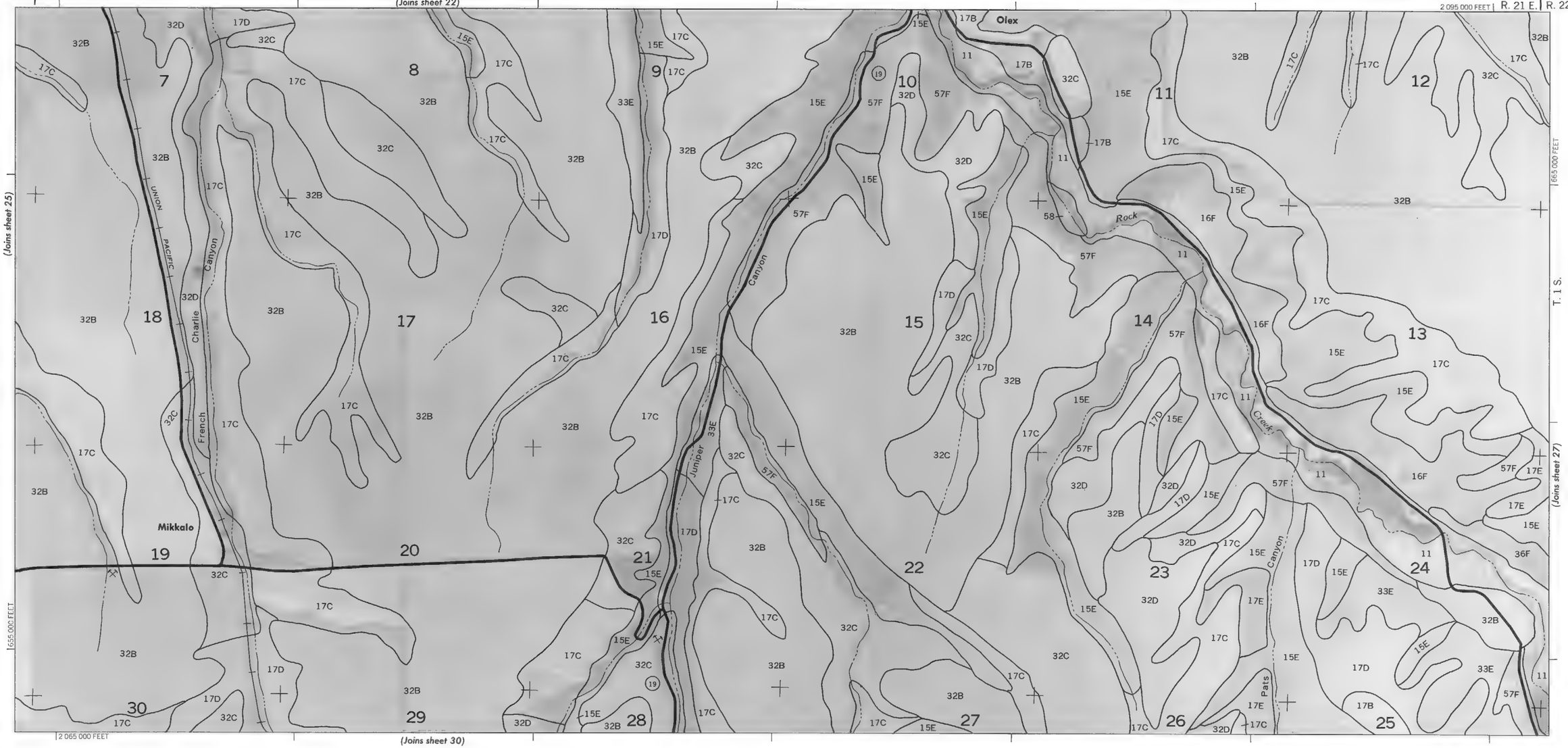
R. 19 E. | R. 20 E.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

N

R. 20 E. | R. 21 E. | (Joins sheet 22) | 2 095 000 FEET | R. 21 E. | R. 22 E.



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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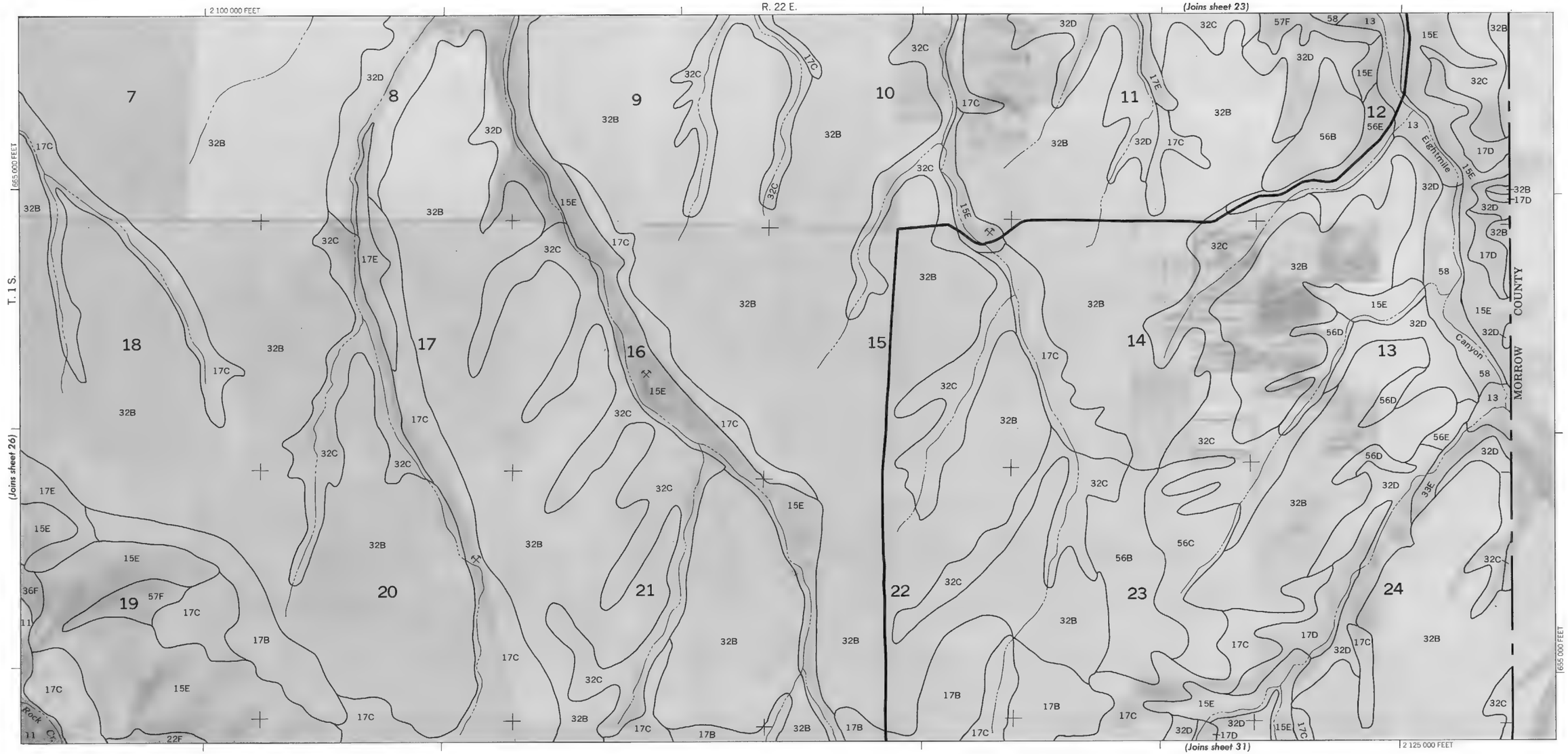
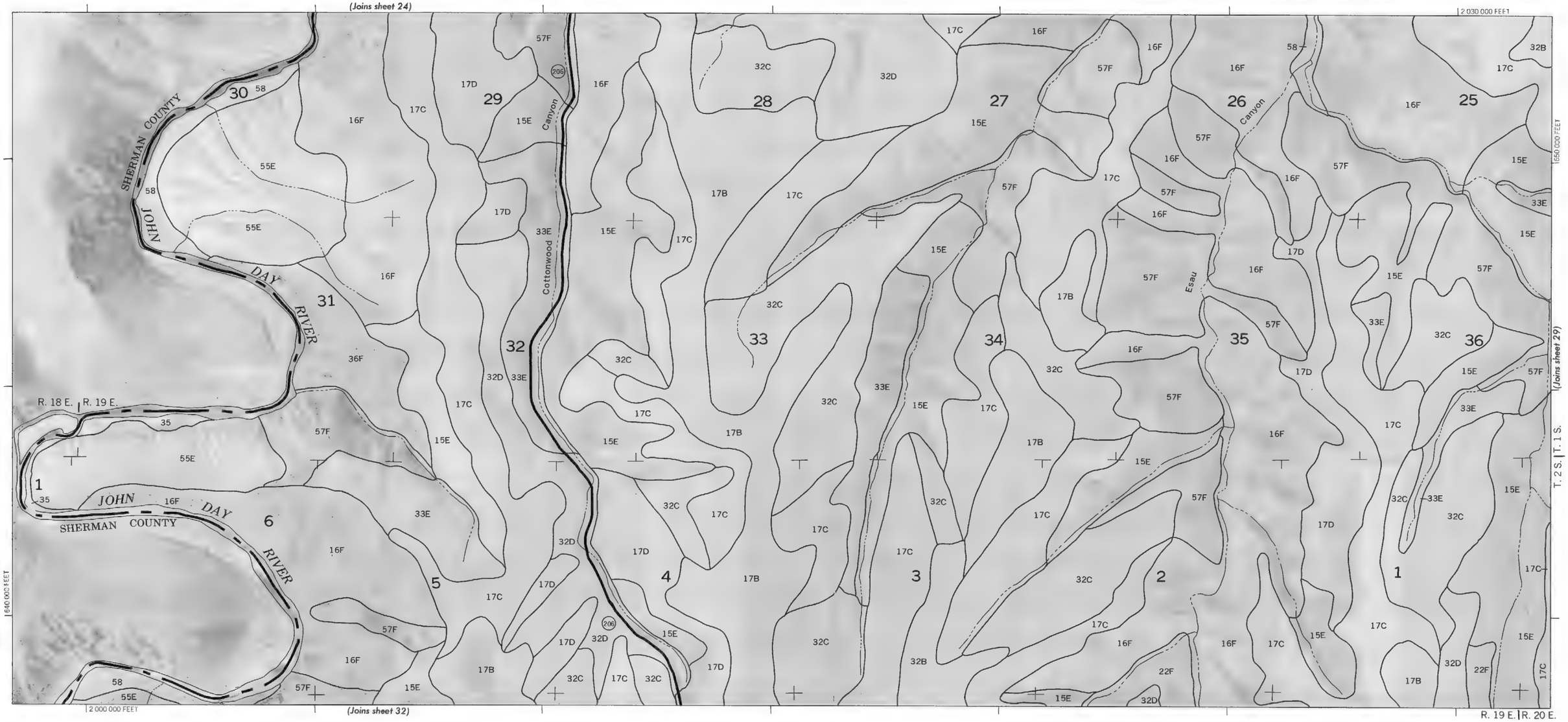
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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N

R. 19 E. | R. 20 E.

2 035 000 FEET

1650 000 FEET

T. 2 S. | T. 1 S.

640 000 FEET

2 060 000 FEET

(Joins sheet 25)

(Joins sheet 28)

(Joins sheet 30)

(Joins sheet 33)

Scott Canyon

Backbone Creek

Sixmile Canyon

Devils Canyon

Hay

This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies.
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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

30

N

R. 20 E. | R. 21 E. | (Joins sheet 26) | 2 095 000 FEET | R. 21 E. | R. 22 E.

(Joins sheet 29)

640 000 FEET

2 065 000 FEET

(Joins sheet 34)

650 000 FEET

(Joins sheet 31)

T. 2 S. | T. 1 S.

Juniper Canyon

Scott Canyon

Clem

Pats Canyon

UNION PACIFIC

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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N

2 100 000 FEET

R. 22 E.

(Joins sheet 27)

650 000 FEET

T. 2 S. | T. 1 S.

(Joins sheet 30)

MORROW COUNTY

640 000 FEET

(Joins sheet 35)

2 125 000 FEET

Rock Creek

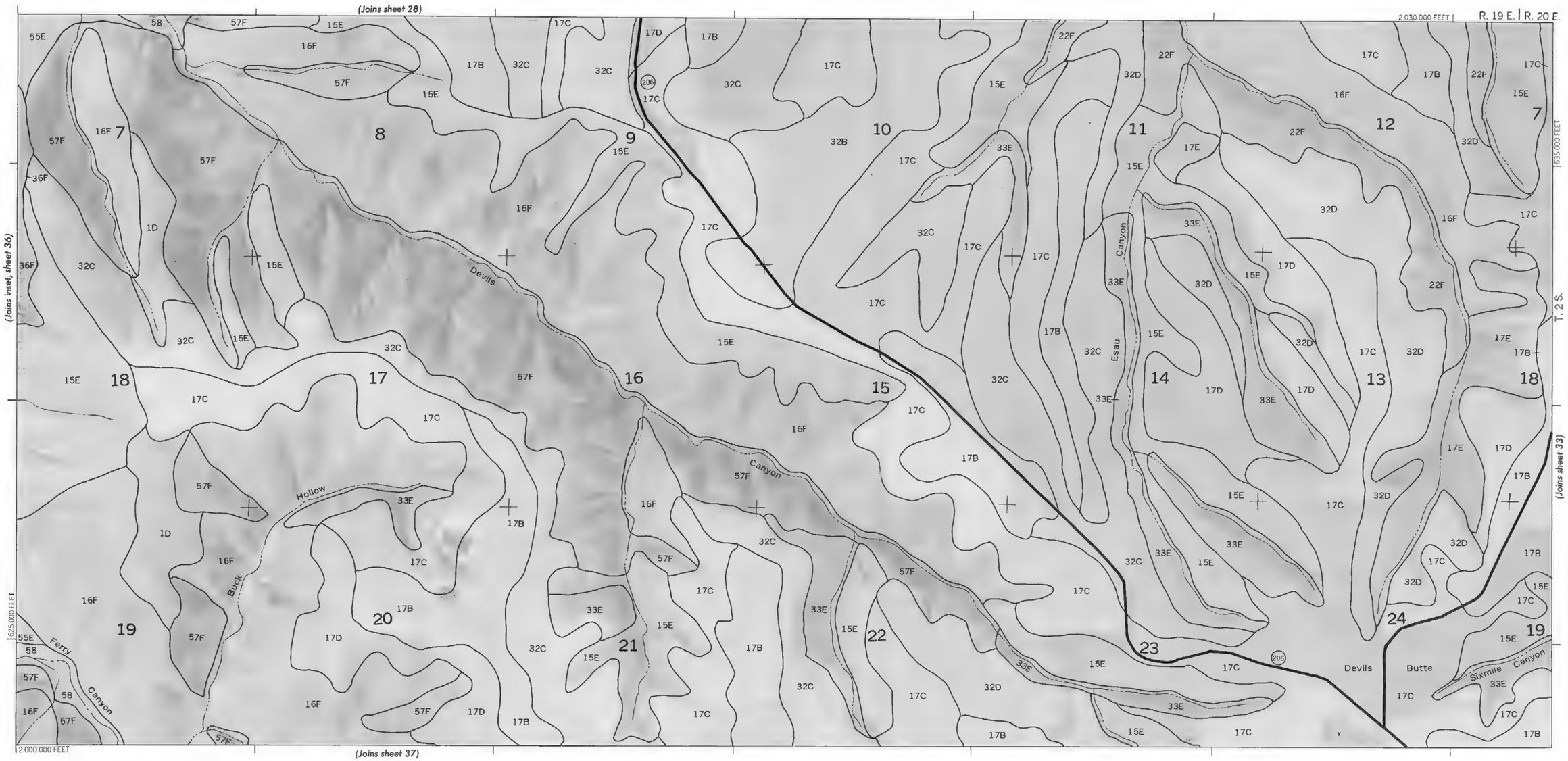
Spring Hollow

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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N

2 035 000 FEET

R. 20 E.

(Joins sheet 29)

635 000 FEET

T. 2 S.

(Joins sheet 32)

(Joins sheet 34)

625 000 FEET

(Joins sheet 38)

2 060 000 FEET

Backbone Canyon

Devils Canyon

Hay Creek

Sixmile Creek

Hollow

Corral

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N

R. 20 E. | R. 21 E. | R. 21 E. | R. 22 E.

(Joins sheet 30)

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 39)

2 095 000 FEET

2 065 000 FEET

635 000 FEET

625 000 FEET

T. 2 S.

Scott Canyon

UNION PACIFIC

7 8 9 10 11 12

18 17 16 15 14 13

19 20 21 22 23 24

32C 33E 32D 17D 15E 17B 17C 32B 17E 22F 16F 57F

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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N

2 100 000 FEET

635 000 FEET

R. 22 E.

T. 2 S.

(Joins sheet 31)

(Joins sheet 34)

(Joins sheet 40)

2 125 000 FEET

625 000 FEET

MORROW COUNTY

Rock Creek

Hollow

Spring

Wolf Hollow

Waterfalls Hollow

Creek

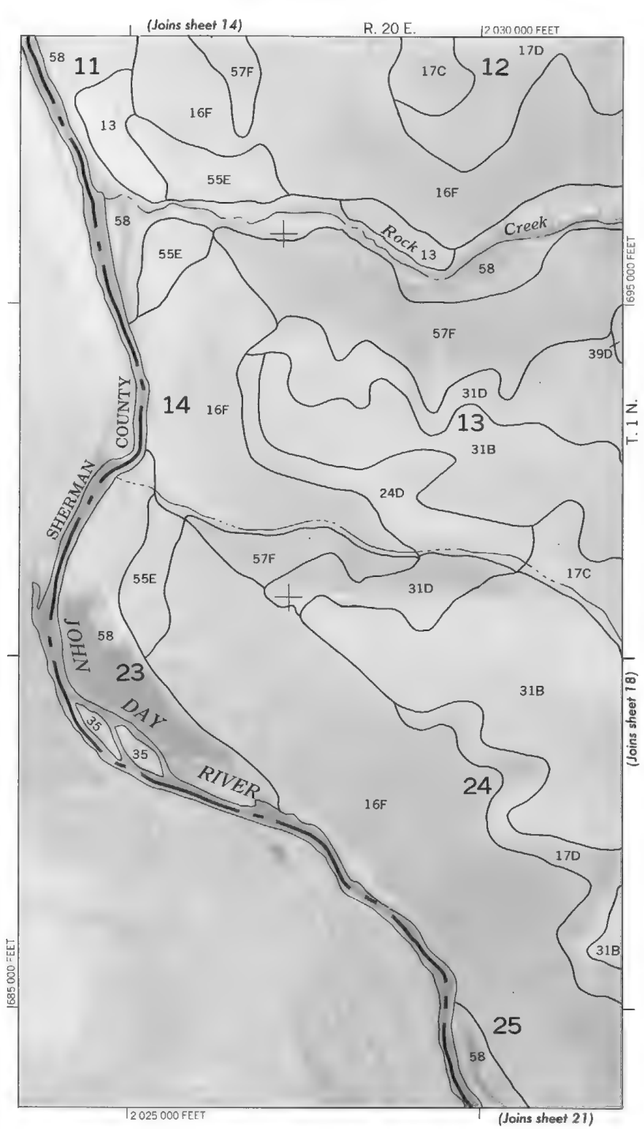
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

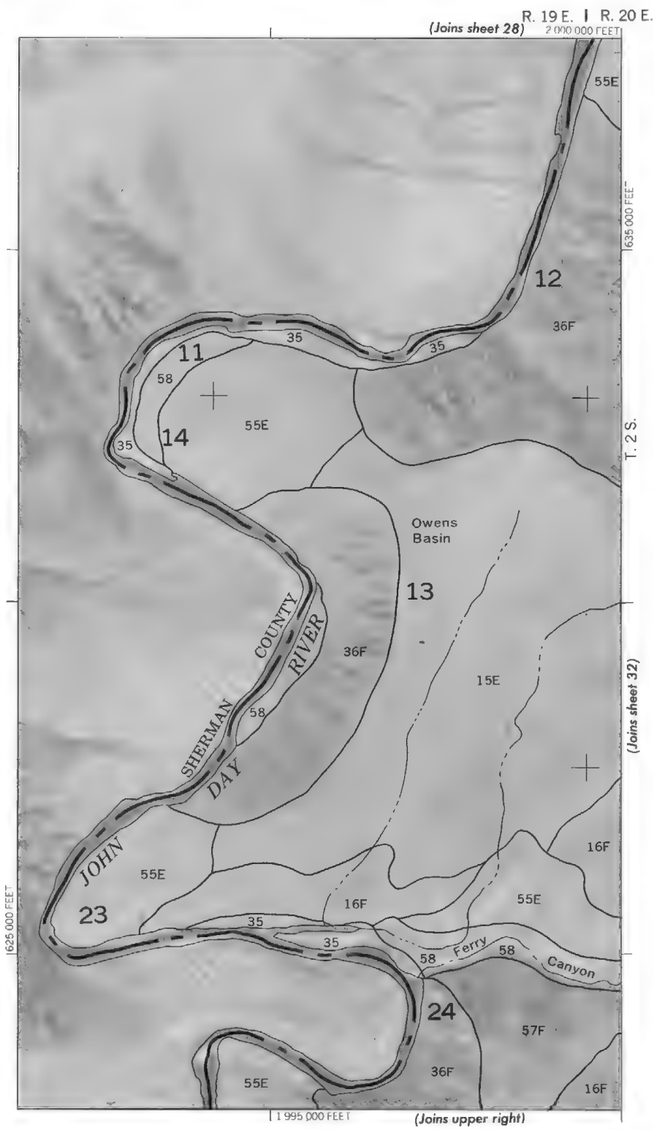
Scale 1:24 000

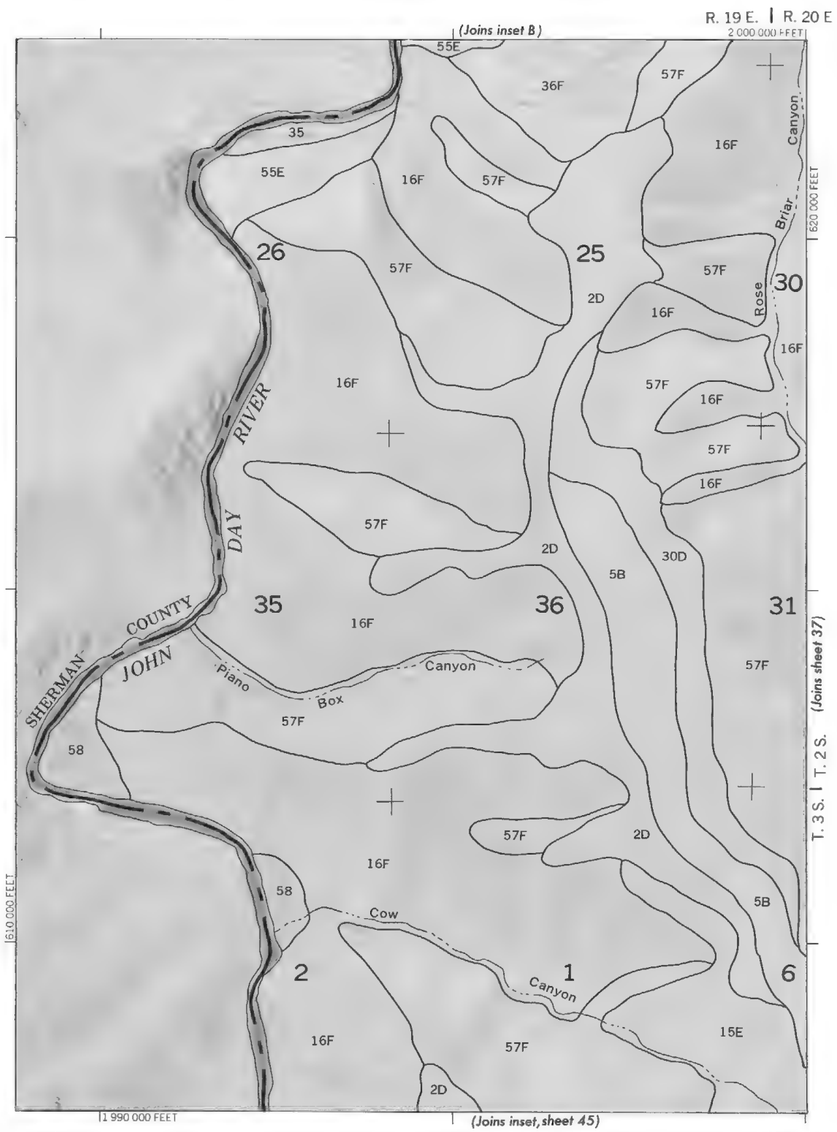
N

INSET A



INSET B





1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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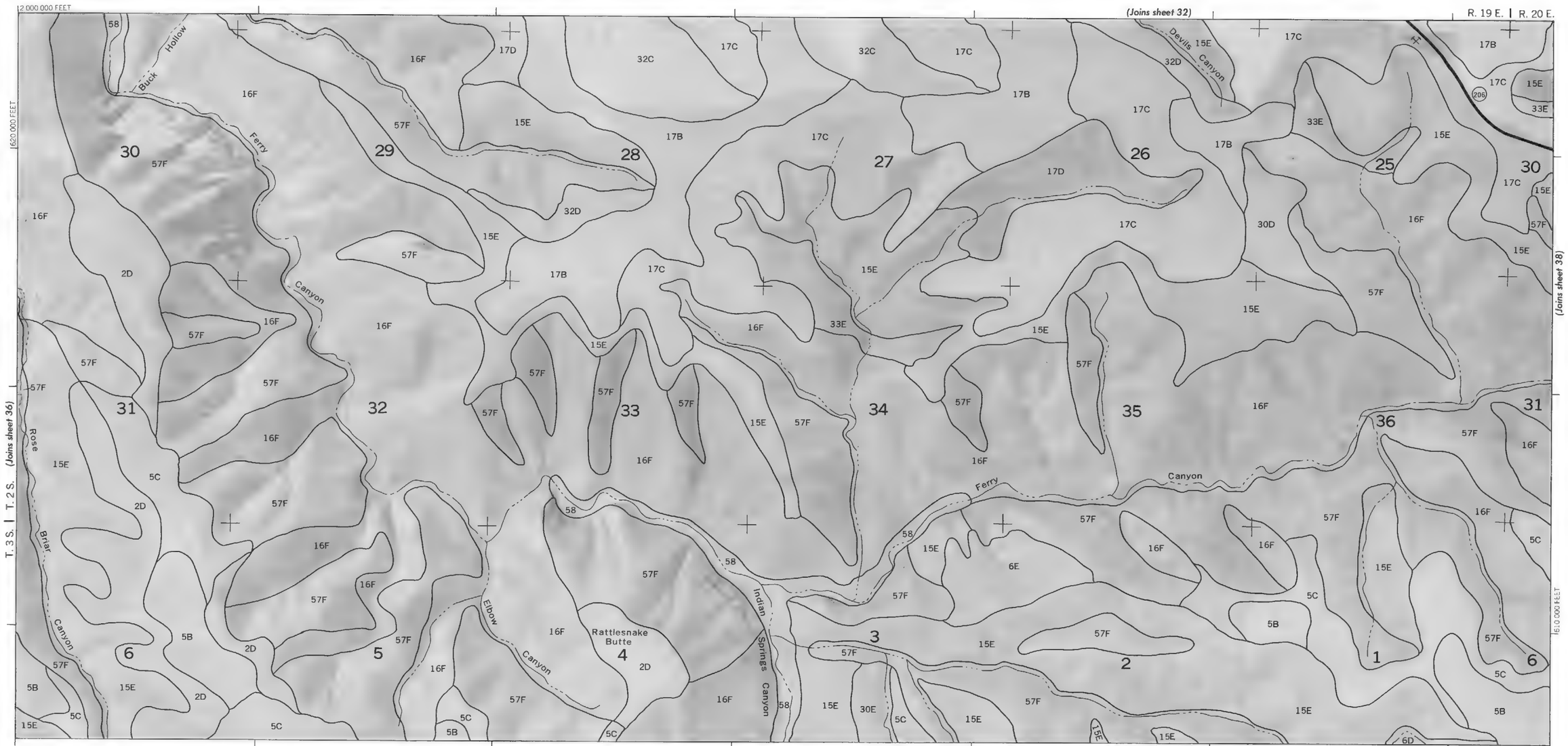

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

38

N

(Joins sheet 33)

R. 20 E.

2 060 000 FEET

620 000 FEET

(Joins sheet 37)

610 000 FEET

2 035 000 FEET

(Joins sheet 42)

T. 3 S. | T. 2 S. (Joins sheet 39)

Hay Creek

Corral Hollow

Hay Creek

Tenmile Canyon

Ferry Canyon

30 29 28 27 26 25

31 32 33 34 35 36

6 5 4 3 2 1

206

58

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

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N

R. 20 E. | R. 21 E. | R. 21 E. | R. 22 E.

2 065 000 FEET

620 000 FEET

(Joins sheet 34)

(Joins sheet 38)

(Joins sheet 40)

(Joins sheet 43)

T. 3 S. | T. 2 S.

2 095 000 FEET

610 000 FEET

Wester Butte

Hay Creek Butte

Road Canyon

Grieb

Dry Fork Hay Creek

Canyon

Spring Hollow

Cayuse Canyon

Gwendolen

UNION PACIFIC

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

(Joins sheet 35)

R. 22 E.

2 125 000 FEET

620 000 FEET

(Joins sheet 39)

T. 3 S. | T. 2 S.

610 000 FEET

2 100 000 FEET

(Joins sheet 44)

MORROW COUNTY

Spring Hollow
Wolf Hollow
Hollow
Waterfalls
Rock Creek
Dry Creek
Cayuse Canyon
Rock Creek

19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
6 5 4 3 2 1

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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2 000 000 FEET

605 000 FEET

R. 19 E. | R. 20 E.

T. 3 S.

(Joins sheet 37)

(Joins inset, sheet 45)

(Joins sheet 42)

(Joins sheet 46)

595 000 FEET

2 030 000 FEET

Cow Canyon
Briar Canyon
Rose Canyon
Spring Canyon
Indian Canyon
Pumphouse Canyon
Simmons Canyon
Fitzwater Canyon
Juniper Canyon
Lamberson Canyon
Shellrock Canyon

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

42

N

(Joins sheet 38)

R. 20 E.

2 060 000 FEET

605 000 FEET

T. 3 S.

(Joins sheet 41)

1595 000 FEET

(Joins sheet 43)

2 035 000 FEET

(Joins sheet 47)

Tenmile

Ferry

Canyon

Lamberson

IGO CEMETERY

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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N

R. 20 E. | R. 21 E. | R. 21 E. | R. 22 E.

2 065 000 FEET

1605 000 FEET

T. 3 S.

(Joins sheet 39)

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 48)

2 095 000 FEET

1595 000 FEET

Hay Creek

Creek

Hollow

Coyote

Hay

Hollow

Fork

Hollow

Dry

Johnson

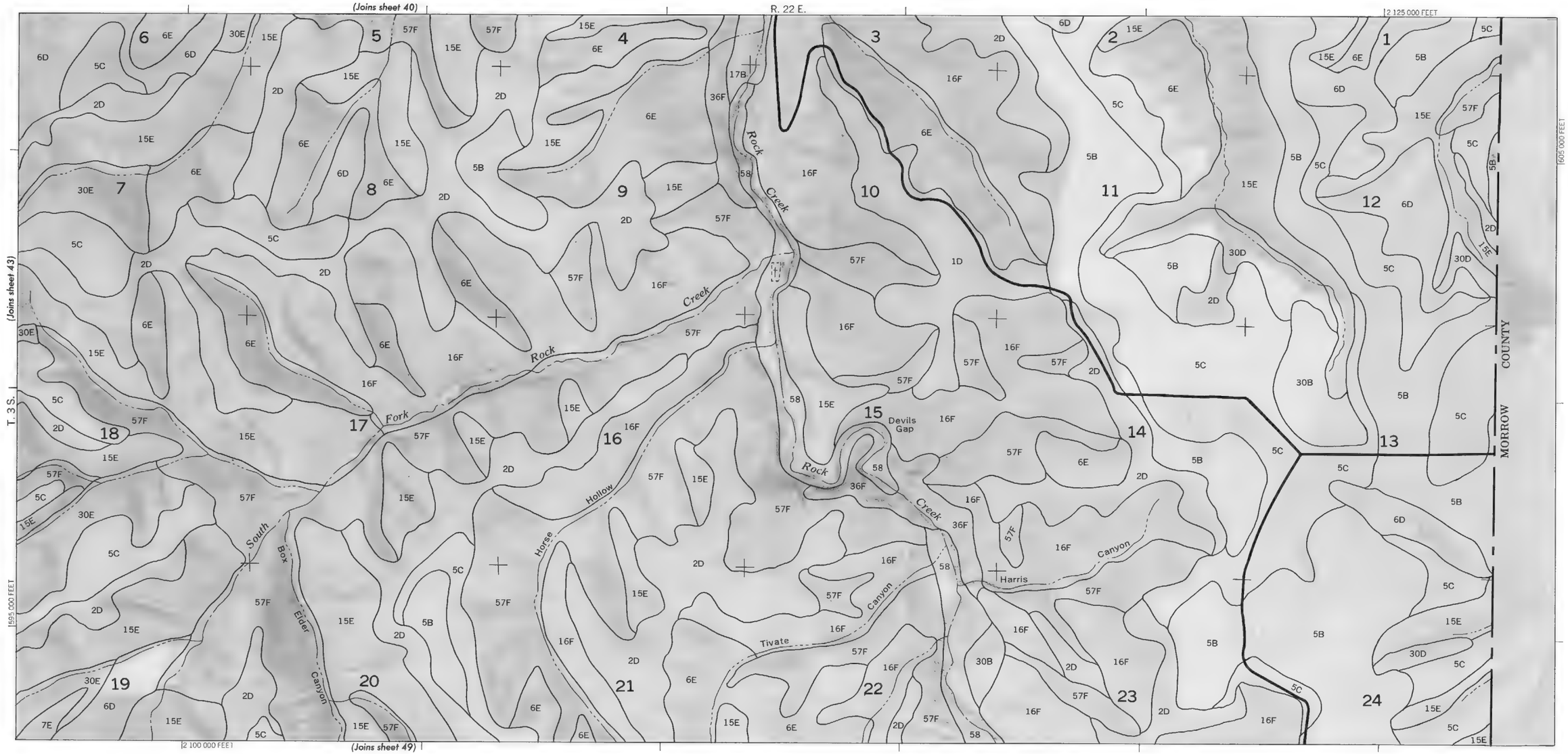
Creek

Hay

UNION PACIFIC

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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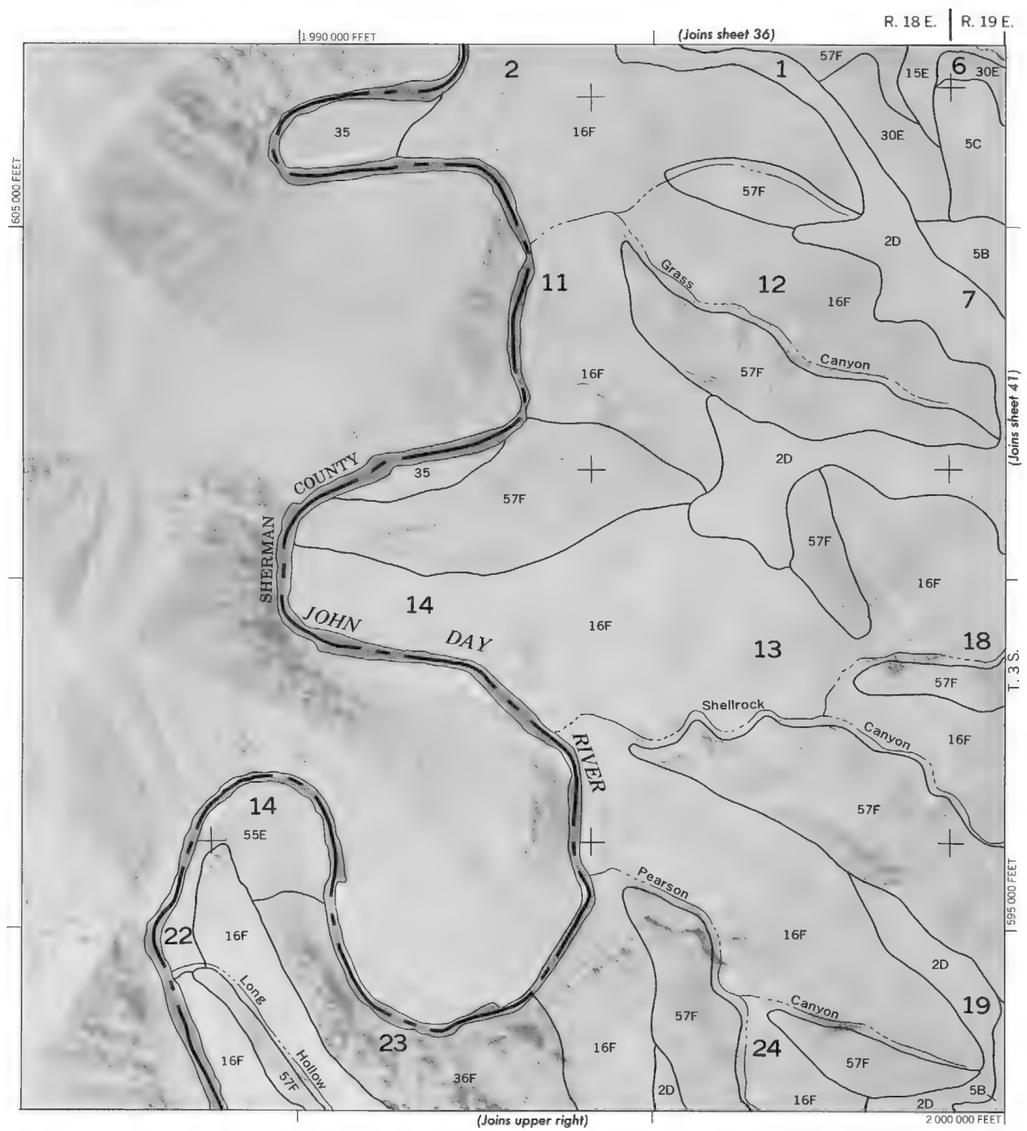
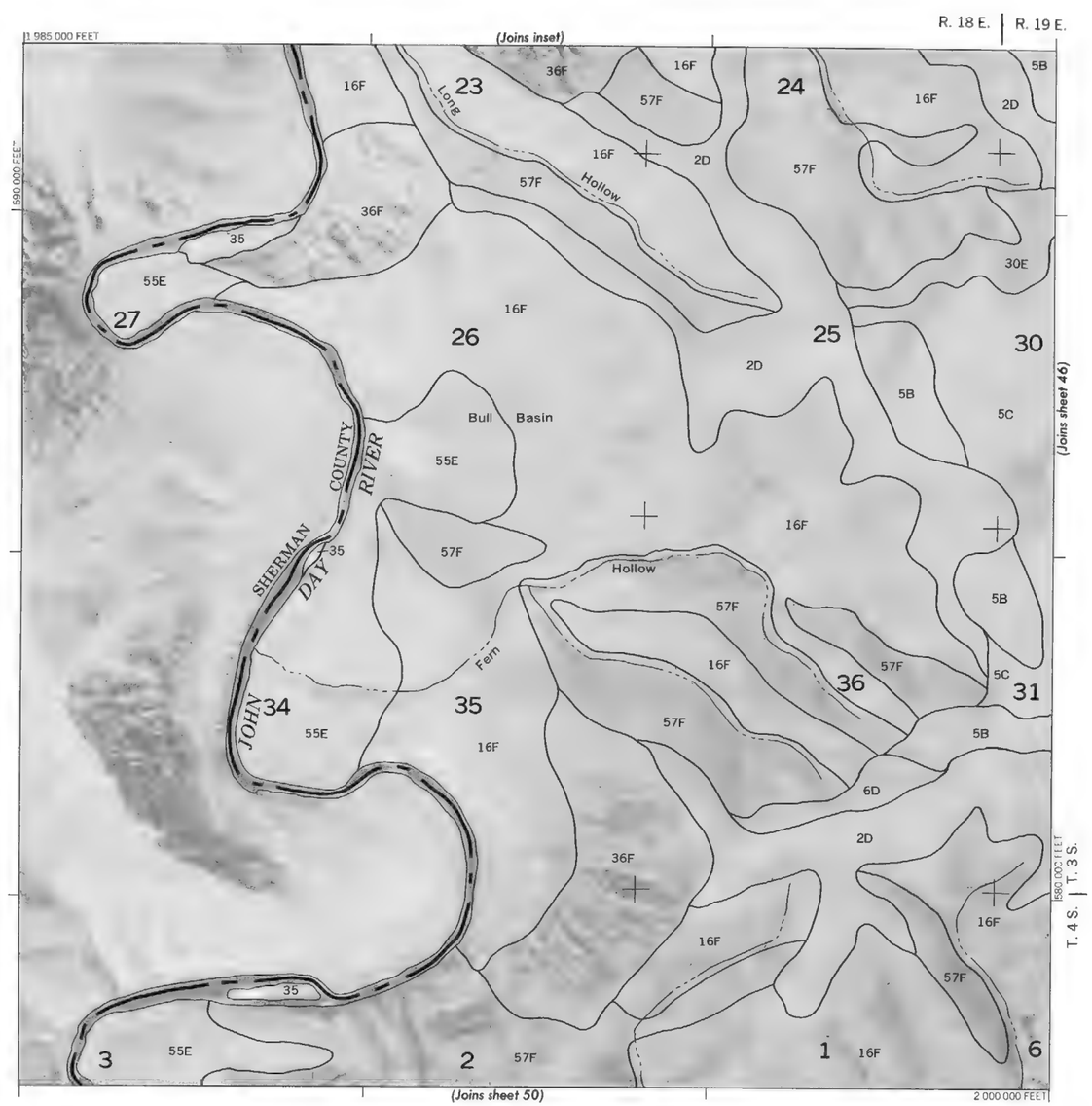
N





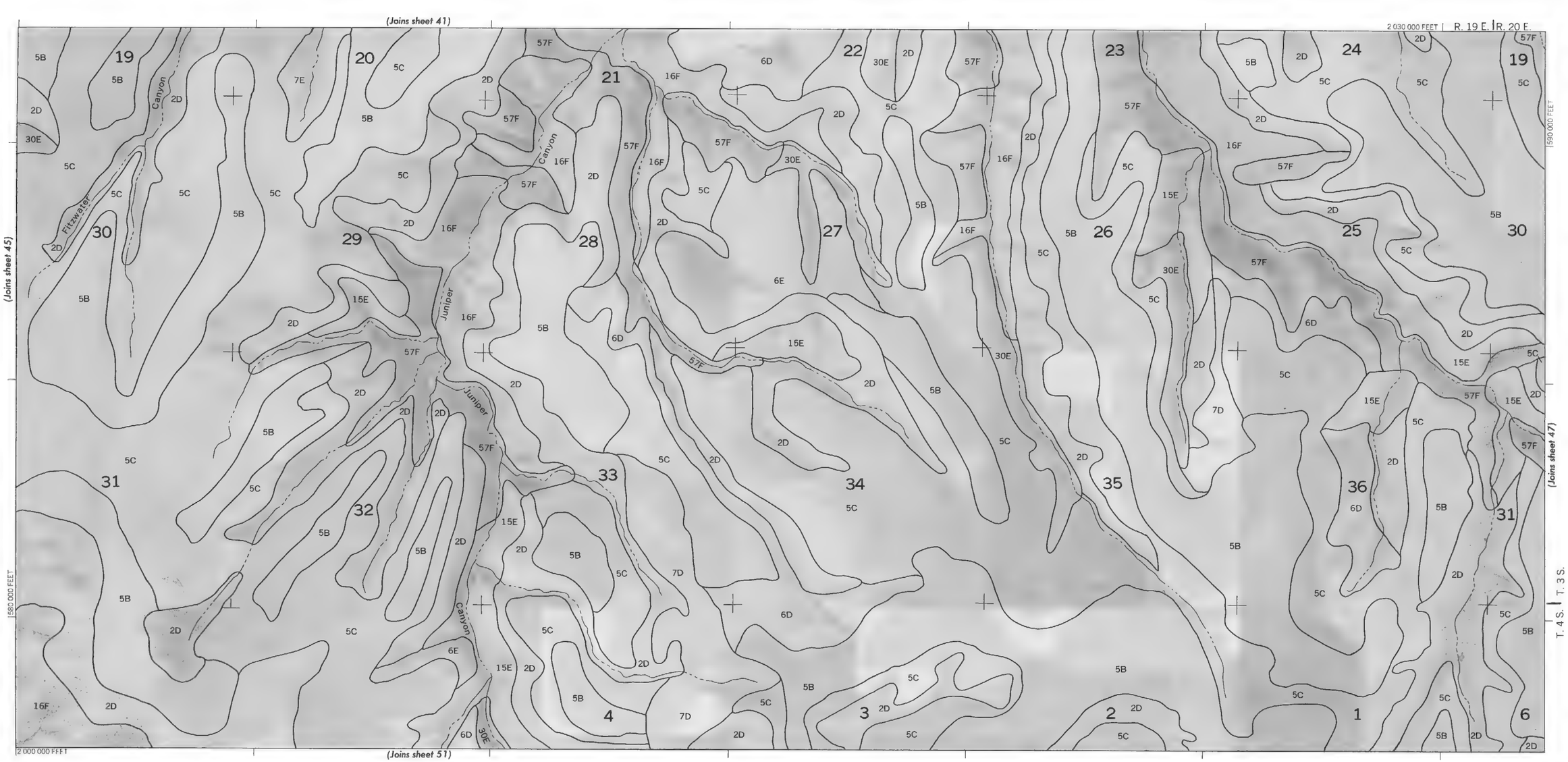
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

46

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 035 000 FEET

590 000 FEET

(Joins sheet 42)

(Joins sheet 48)

(Joins sheet 46)

(Joins sheet 52)

2 050 000 FEET

580 000 FEET

T. 4 S. | T. 3 S.

R. 20 E. | R. 21 E.

Lamberson Canyon

Igo Butte

Canyon

Ferry

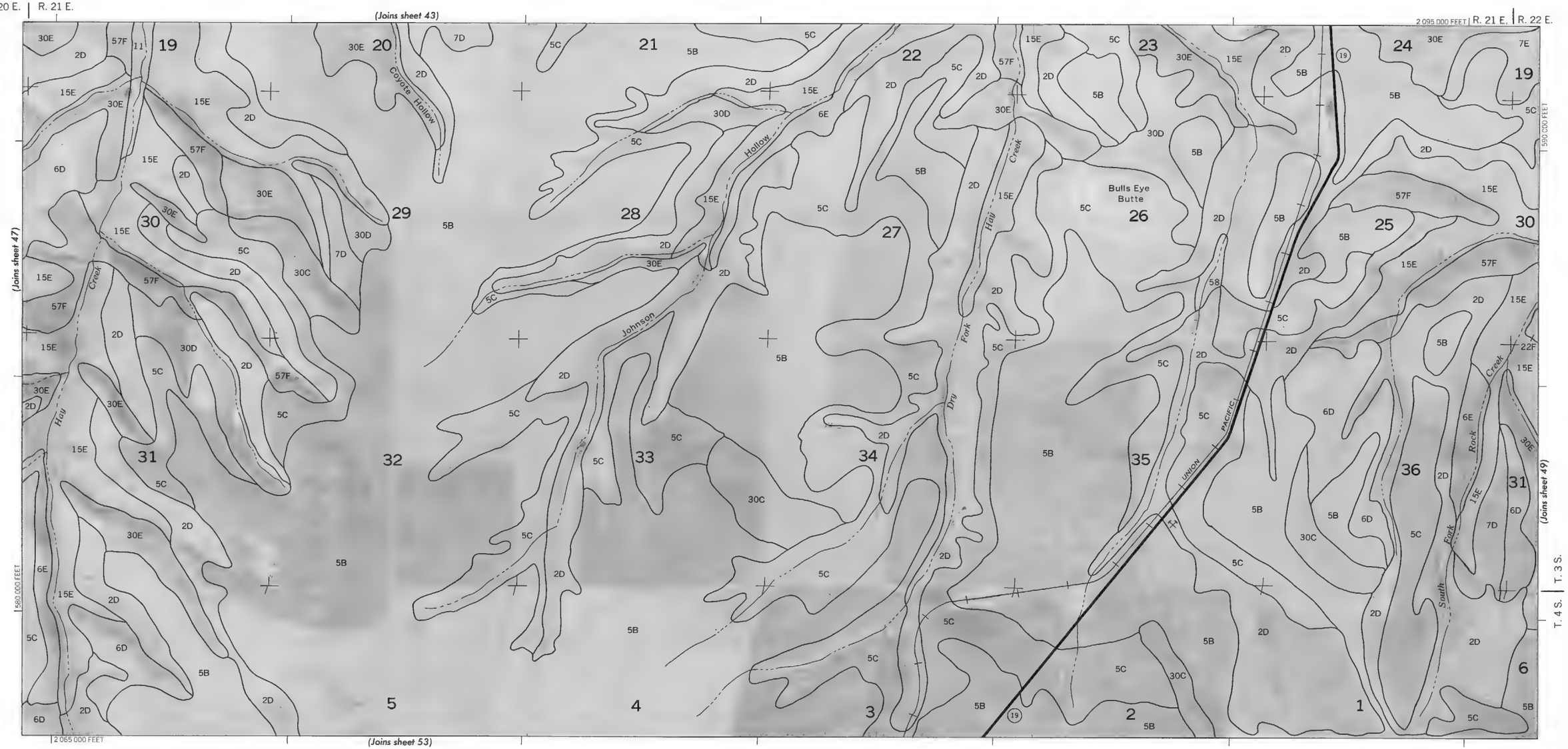
Tenmile Canyon

19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
6 5 4 3 2 1

5B 5C 2D 30D 30E 15E 57F 7D 6D 6E

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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N

2 100 000 FEET

590 000 FEET

(Joins sheet 44)

(Joins sheet 48)

(Joins sheet 54)

(Joins sheet 55)

T. 4 S. | T. 3 S.

2 125 000 FEET R. 22 E. | R. 23 E.

580 000 FEET

MORROW COUNTY

Rock Creek

South Fork Rock Creek

Box Elder Canyon

Horse Hollow

Tivate Canyon

Wallace Canyon

Rock Canyon

Sixmile Creek

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

50

N

INSET A

2 000 000 FEET

R. 18 E. | R. 19 E.

525 000 FEET

25

30E

35

58

36F

36

SHERMAN COUNTY

JOHN DAY RIVER

16F

WASCO COUNTY

T. 6 S. | T. 5 S.

(Joins sheet 73) (Joins sheet 67)

565 000 FEET

515 000 FEET

1 996 000 FEET

4000 AND 5000-FOOT GRID TICKS

INSET B

(Joins lower right)

R. 18 E. | R. 19 E.

2 000 000 FEET

563 000 FEET

58

55E

23

16F

Canyon

24

2D

JOHN DAY RIVER

Cordwood

16F

55E

SHERMAN COUNTY

25

T. 4 S.

(Joins sheet 56)

557 000 FEET

1 990 000 FEET

4000 AND 5000-FOOT GRID TICKS

R. 18 E. | R. 19 E.

2 000 000 FEET

(Joins sheet 45)

575 000 FEET

55E

3

57F

2

16F

1

Canyon

57F

16F

35

10

Buckskin

55E

2D

16F

58

57F

SHERMAN COUNTY

55E

11

12

T. 4 S.

57F

2D

35

Potlatch

16F

Canyon

57F

2D

16F

JOHN DAY RIVER

14

57F

(Joins sheet 51)

35

58

Horseshoe Bend

36F

13

6D

2D

14

57F

16F

55E

Canyon

35

23

16F

24

58

55E

Cordwood

57F

2D

(Joins inset B)

1 970 000 FEET

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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N

2 000 000 FEET

1 575 000 FEET

(Joins sheet 46)

R. 19 E. | R. 20 E.

T. 4 S.

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 56)

2 030 000 FEET

1 565 000 FEET

Buckskin Canyon
Juniper Canyon
Cushman Canyon
Nelson Butte
Potlatch Canyon
Cordwood Canyon
Crazy Hollow
Richmond Canyon
Meldrum Canyon
Juniper Canyon
Cason Canyon

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

2D 5B 5C 6D 6E 7D 15E 16F 30E 57F L

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N

(Joins sheet 47)

2 060 000 FEET

R. 20 E. | R. 21 E.

575 000 FEET

T. 4 S.

(Joins sheet 51)

(Joins sheet 53)

565 000 FEET

2 035 000 FEET

(Joins sheet 57)

Juniper Canyon

Cason Canyon

Schott Canyon

Shoestring Ridge

Stebbins Ridge

Mathis Hollow

Buck Hollow

Zero Butte

Crazy Fork

Sunshine Canyon

1 ⅜ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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N

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 065 000 FEET

575 000 FEET

565 000 FEET

2 095 000 FEET

R. 21 E. | R. 22 E.

T. 4 S.

(Joins sheet 48)

(Joins sheet 52)

(Joins sheet 54)

(Joins sheet 58)

CONDON
(County Seat)

Condon Airfield

UNION PACIFIC

Condon

Canyon

Dry Fork

Thirtymile Creek

Crazy Fork

Shinton Canyon

Scale 1:24 000

1 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

54

N

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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N

2 130 000 FEET

580 000 FEET

(Joins sheet 54)

(Joins sheet 49)

MORROW COUNTY

R. 23 E.

T. 4 S.

COUNTY MORROW

565 000 FEET

2 160 000 FEET

(Joins sheet 60)

Rock Creek

West Fork Rock Creek

East Fork Rock Creek

Dry Creek

Hollow Creek

Bruce Creek

Lone Rock Creek

Billy Can Creek

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

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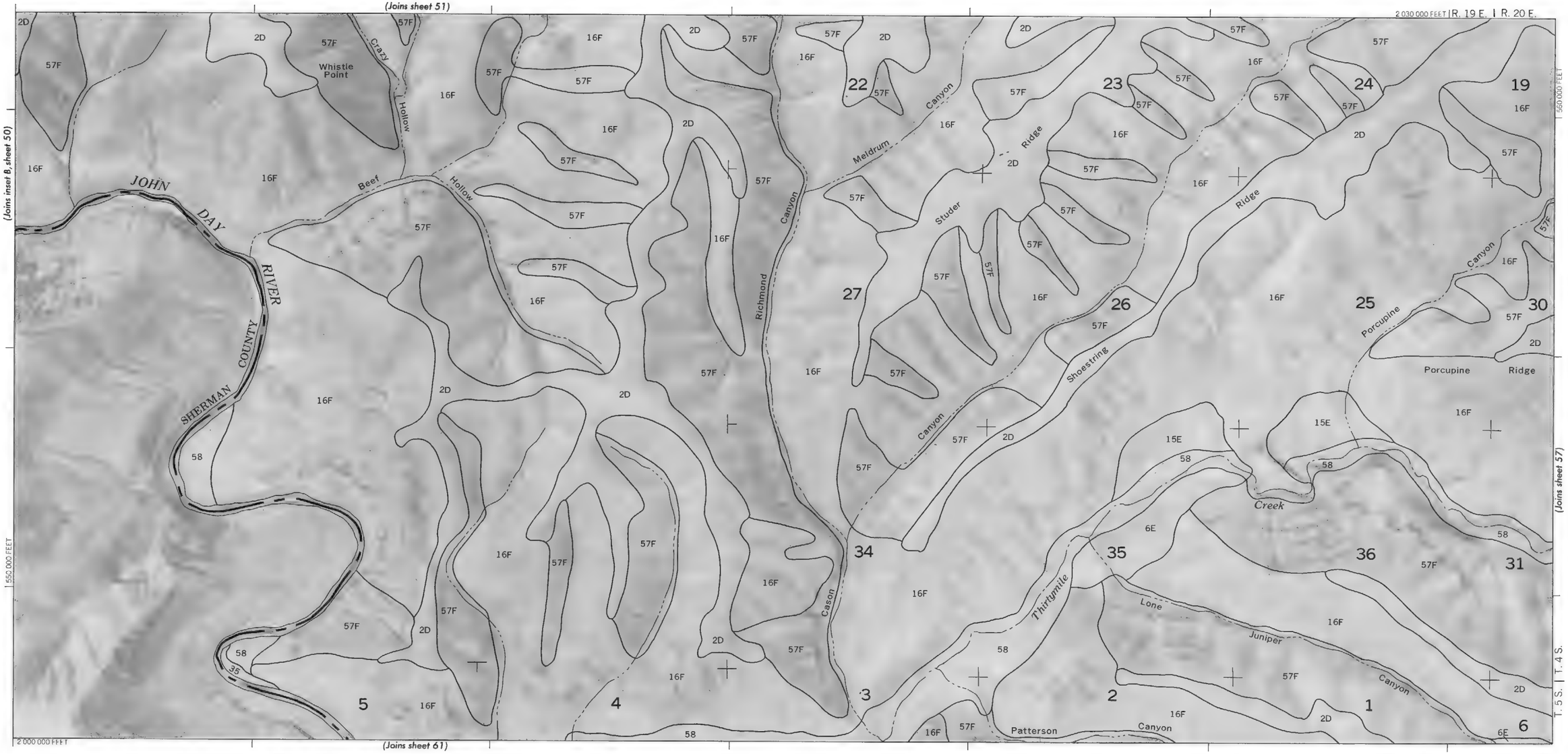
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

56

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
Base maps are orthophotographs prepared by the U.S. Department of the Interior, Geological Survey, from 1977 aerial photography.
This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies.

N

2 035 000 FEET

560 000 FEET

R. 20 E. | R. 21 E.

(Joins sheet 52)

(Joins sheet 58)

(Joins sheet 56)

(Joins sheet 62)

2 060 000 FEET

550 000 FEET

T. 4 S. | T. 5 S.

Coyote Butte

Porcupine Canyon

Porcupine Ridge

Road Canyon

Dog Canyon

Corral Canyon

Yellow Canyon

Thirtymile Creek

Cave Canyon

Schott Canyon

Stebbins Ridge

Squaw Hollow

Buck Hollow

Willow Canyon

Sandy Canyon

Sunshine Canyon

Sniption Canyon

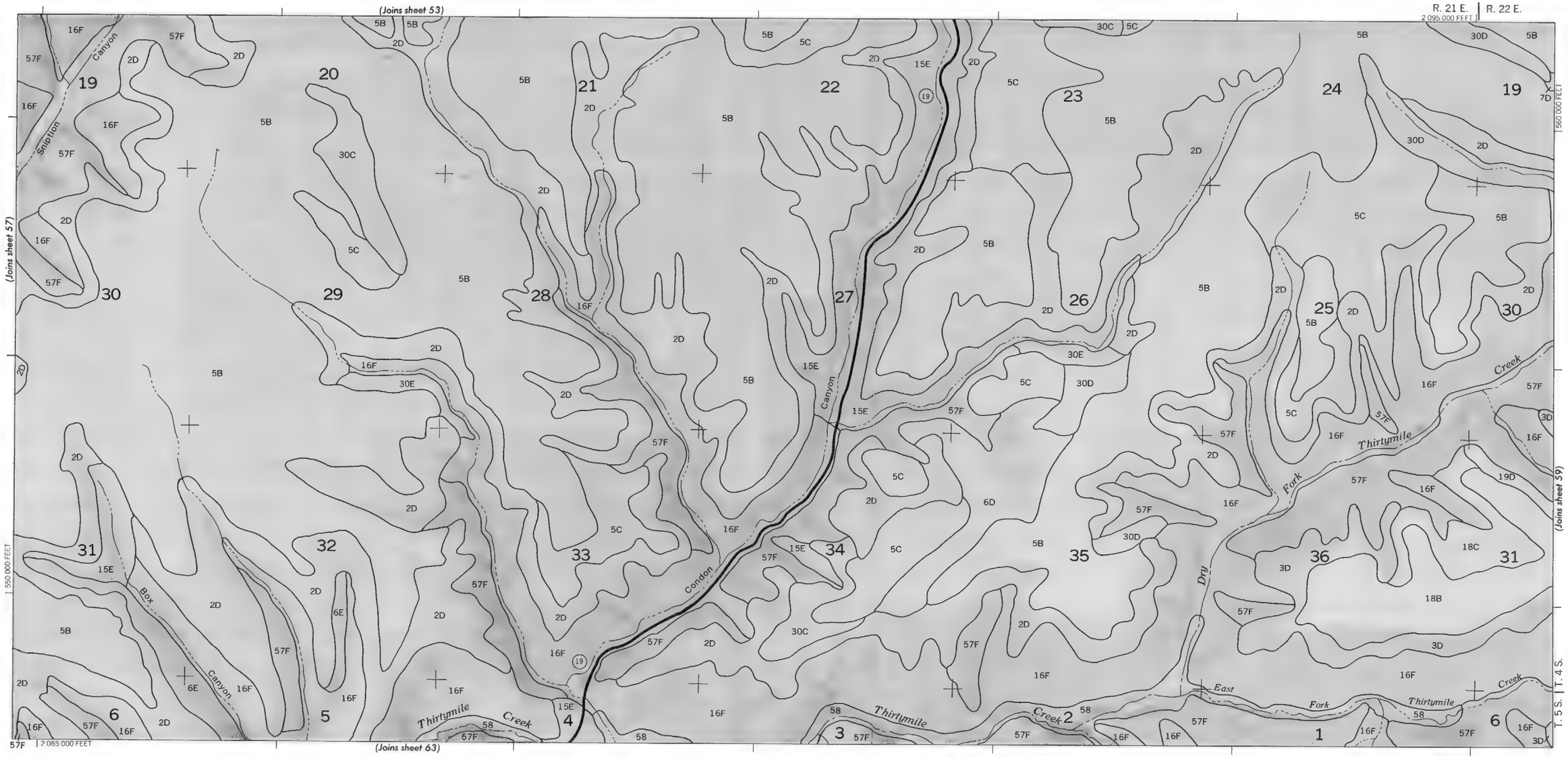
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

58

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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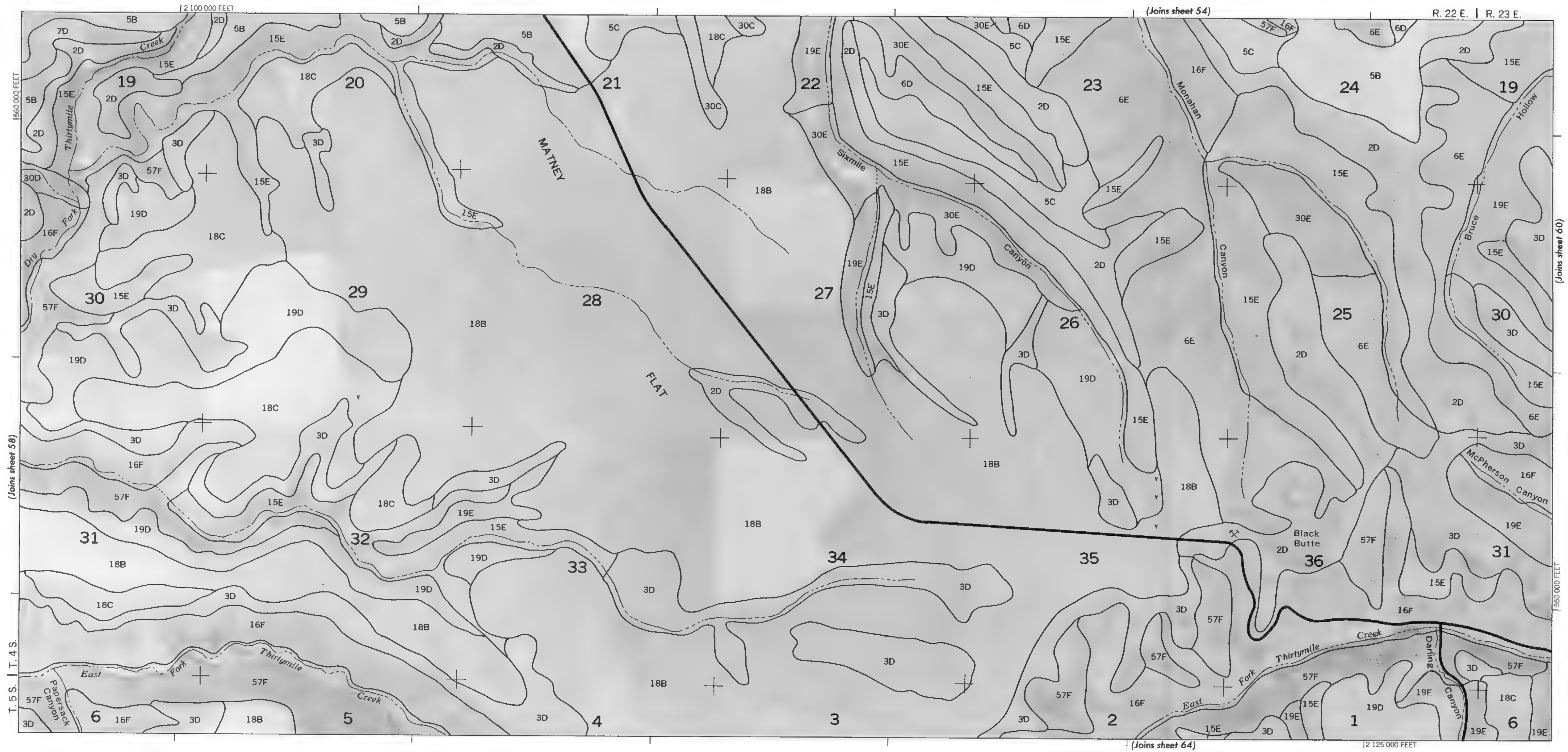
N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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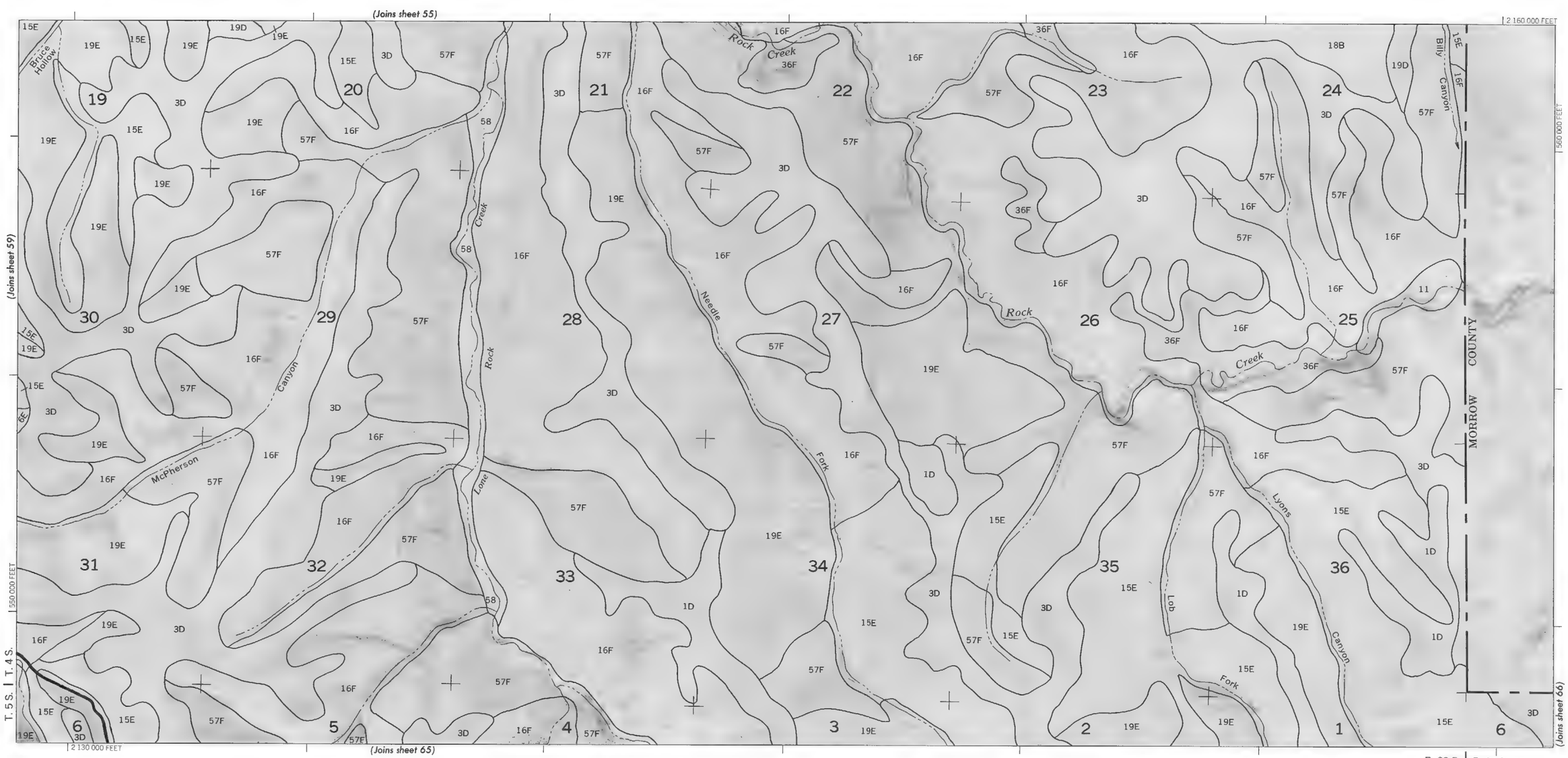
60

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

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N

2 000 000 FEET

545 000 FEET

R. 19 E. | R. 20 E.

(Joins sheet 56)

(Joins sheet 62)

T. 5 S.

535 000 FEET

(Joins sheet 67)

2 030 000 FEET

Thirtymile Creek

Patterson Canyon

Lone Juniper Canyon

Armstrong Canyon

Pemberton Canyon

Devils Canyon

Pine Tree Canyon

Fones Canyon

Smith Canyon

JOHN DAY RIVER

SHERMAN COUNTY

16F 58 6E 36F 57F 55B 13 7E 2D 15E 6D 18C 18B 19D 3D 18 19 20 21 22 23 24

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N

(Joins sheet 57)

2 060 000 FEET

R. 20 E. | R. 21 E.

545 000 FEET

T. 5 S.

(Joins sheet 61)

(Joins sheet 63)

535 000 FEET

2 035 000 FEET

(Joins sheet 68)

Thirtymile Creek

Tucker Canyon

Cope Canyon

Grouse Canyon

Coffin Canyon

Armstrong Canyon

Wehrli Canyon

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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N

2 065 000 FEET

545 000 FEET

R. 21 E. | R. 22 E.

T. 5 S.

(Joins sheet 58)

(Joins sheet 62)

(Joins sheet 64)

(Joins sheet 69)

535 000 FEET

2 095 000 FEET

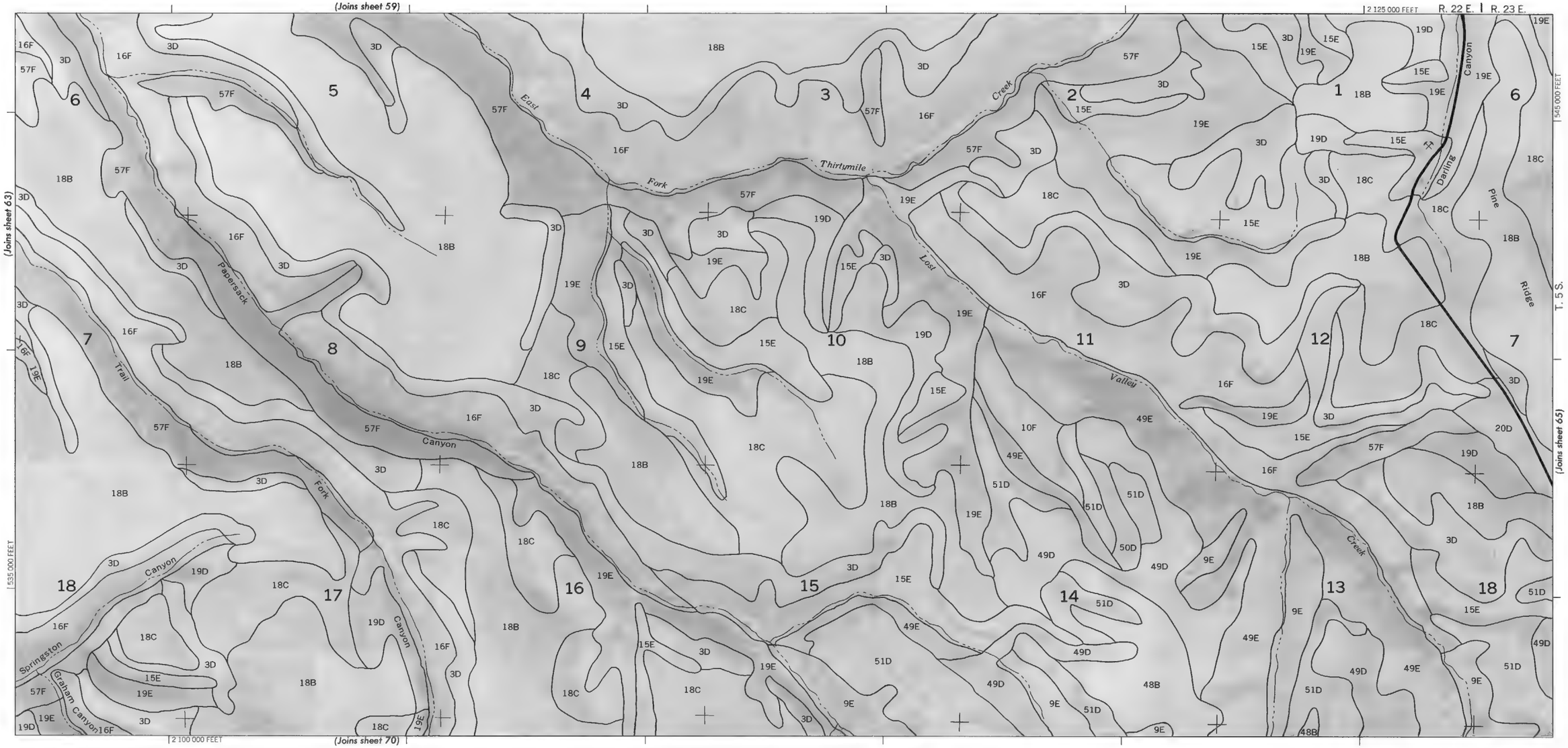
Box Canyon
Thirtymile Creek
Patill Canyon
Wehrli
Greiner
Beecher Flat
Beecher Flats
Canyon
Thirtymile Creek Trail
Fork Canyon
Badger Canyon
Springston Canyon

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.
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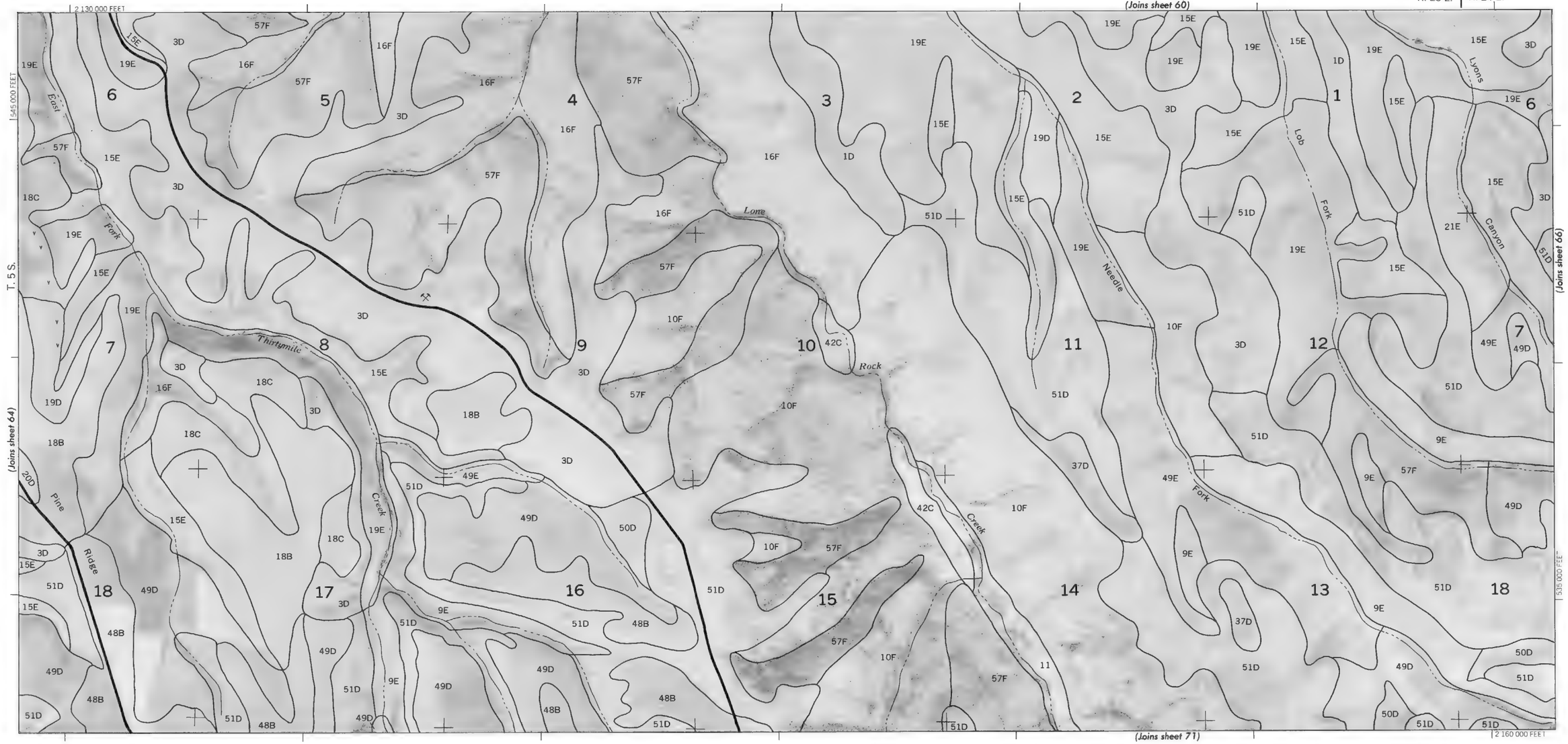
N

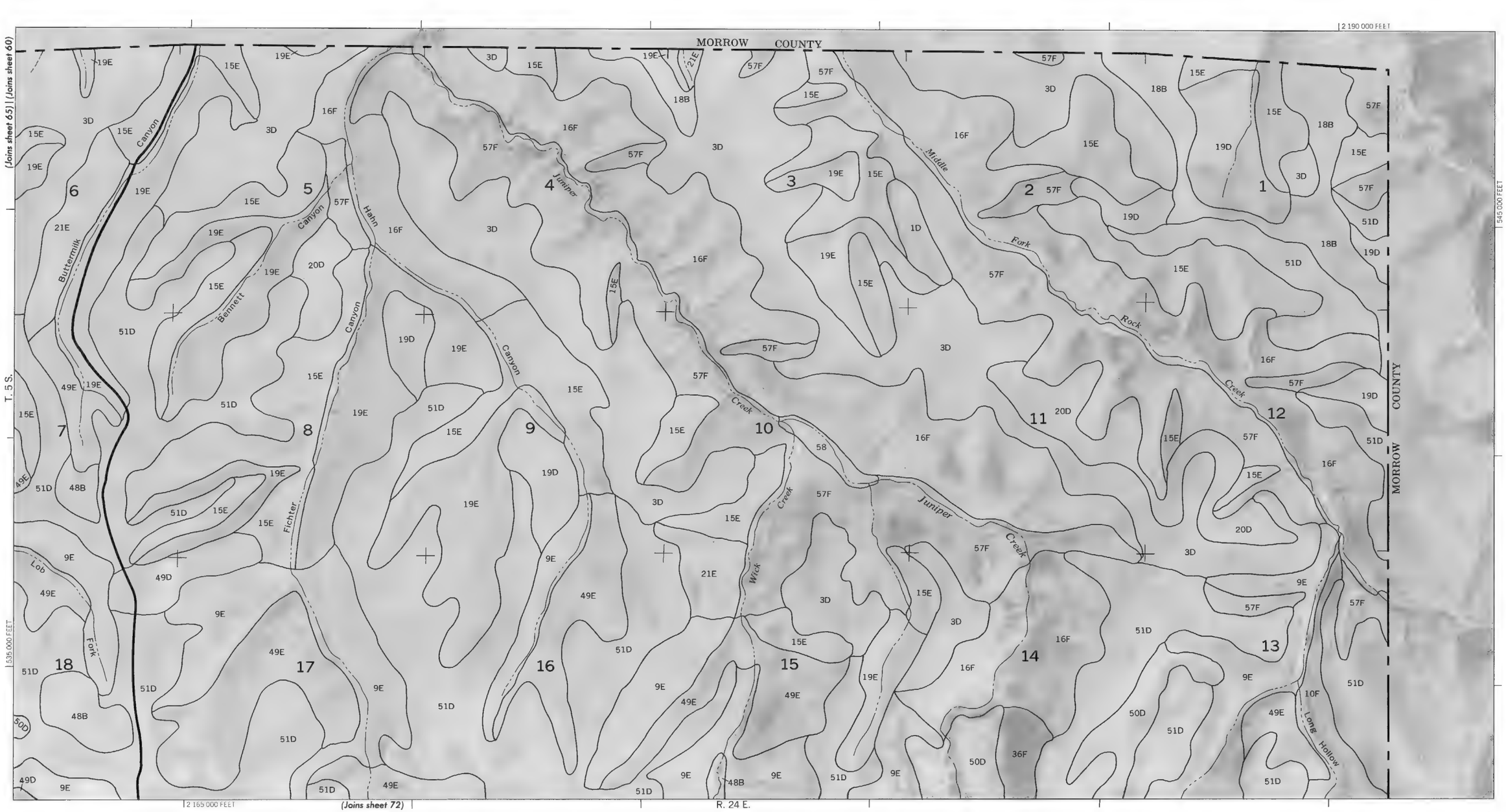


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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N

2 000 000 FEET

530 000 FEET

(Joins inset A, sheet 50)

(Joins sheet 61)

R. 19 E. R. 20 E.

(Joins sheet 68)

(Joins sheet 73)

2 030 000 FEET

520 000 FEET

T. 6 S. T. 5 S.

SHERMAN COUNTY

JOHN DAY RIVER

Pete Envart Canyon

Devils Canyon

South Fork

Horse Mtn.

Brush Hollow

21 22 23 24 19
28 27 26 25 30
29 30 31 32 33 34 35 36

16F 18B 3D 19D 2D 57F 18C 30E 36F 57F 19D

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

68

N

(Joins sheet 62)

R. 20 E. | R. 21 E.

2 060 000 FEET

580 000 FEET

(Joins sheet 67)

(Joins sheet 68)

520 000 FEET

2 035 000 FEET

(Joins inset, sheet 73)

T. 6 S. | T. 5 S.

Buckhorn Canyon

Poodle Canyon

Hunt Canyon

North Fork Butte Creek

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

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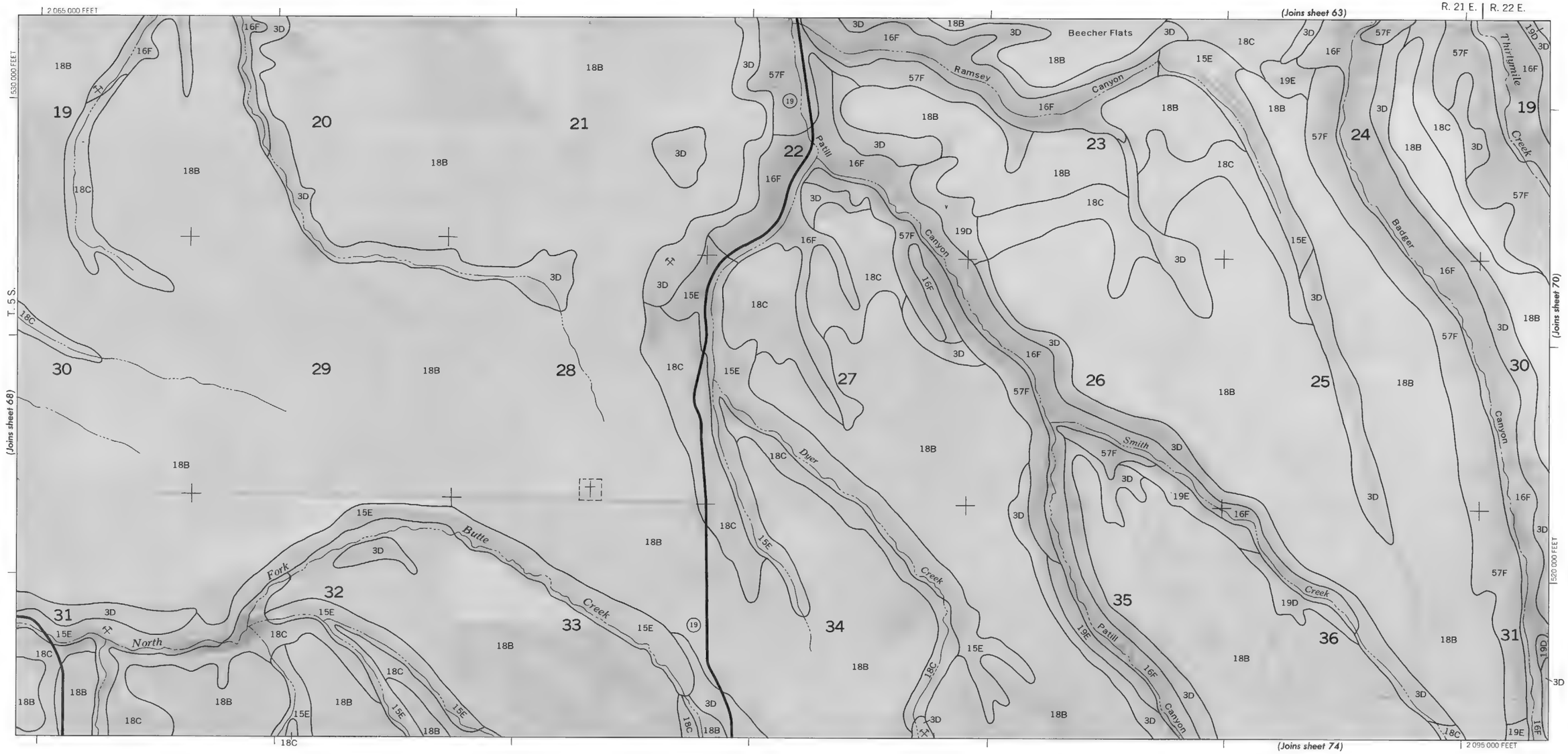
N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

N

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

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N

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 130 000 FEET

530 000 FEET

R. 23 E. | R. 24 E.

(Joins sheet 65)

T. 5 S.

(Joins sheet 70)

(Joins sheet 72)

(Joins sheet 75)

520 000 FEET

2 160 000 FEET

Pine Ridge

East Fork Thirtymile Creek

Lost Valley Creek

Lone Rock Canyon

Robinette Creek

Boone Creek

LOST VALLEY

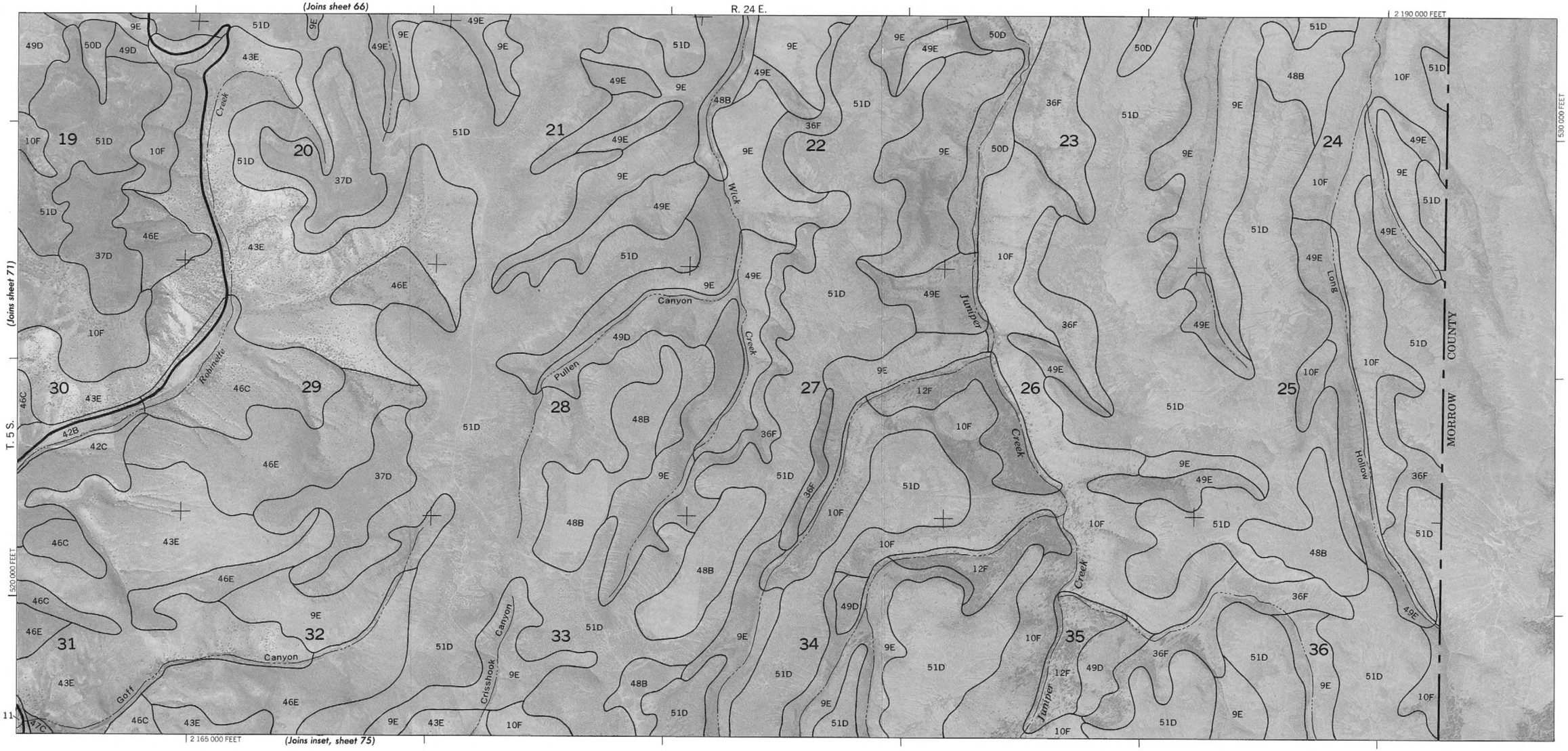
Lonerock

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

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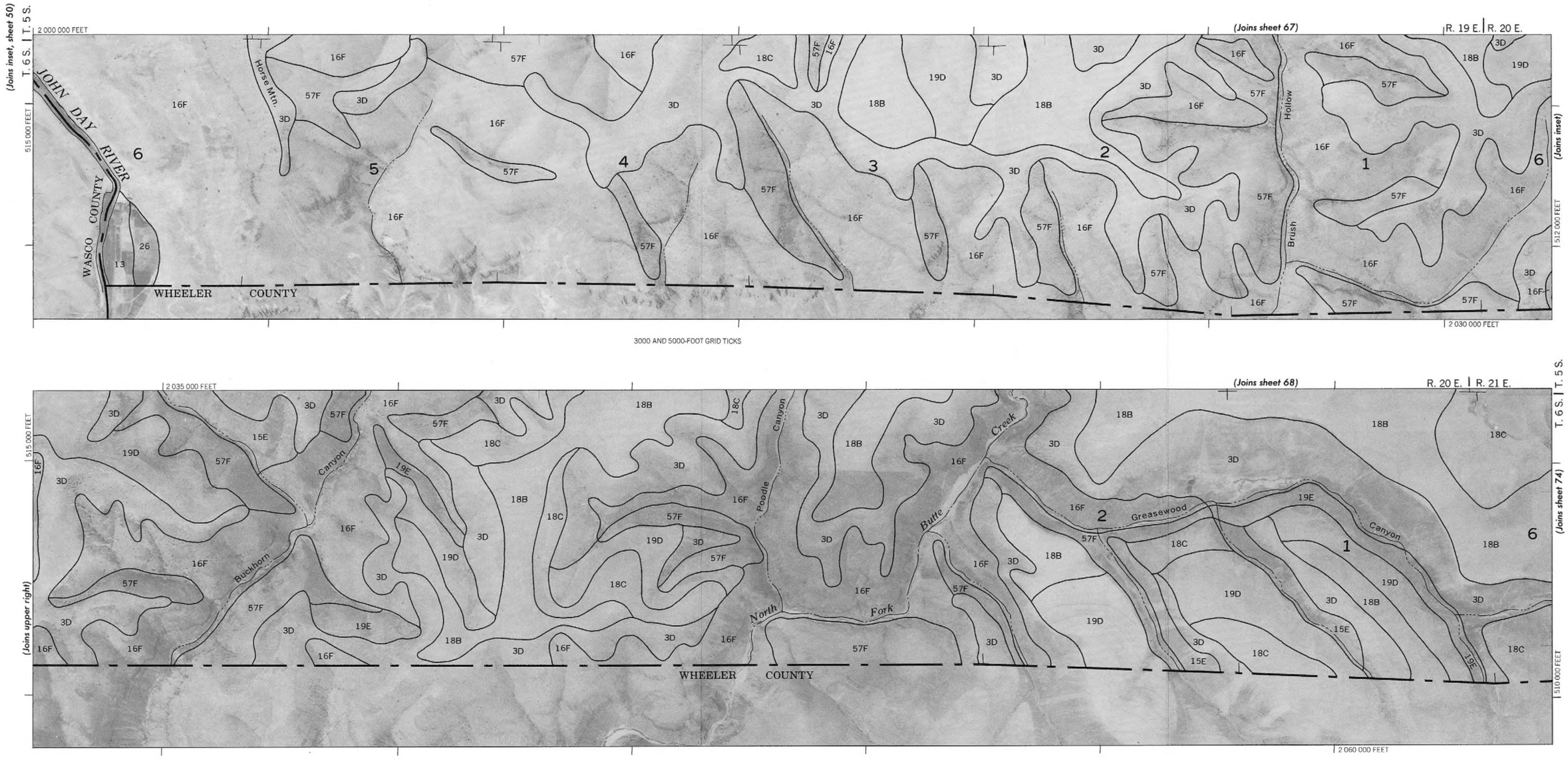
N

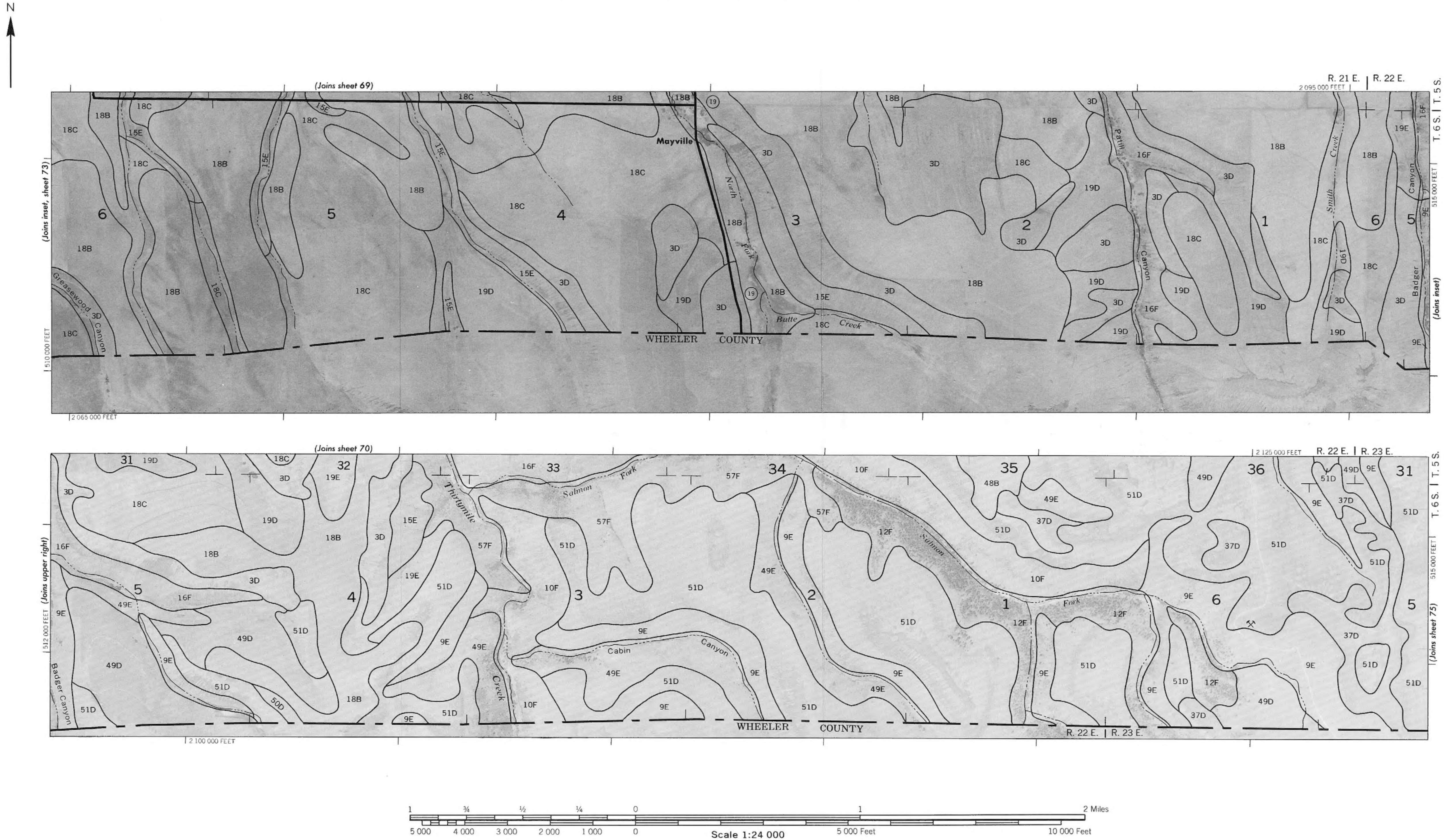


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

SOIL SURVEY OF GILLIAM COUNTY, OREGON — SHEET NUMBER 74



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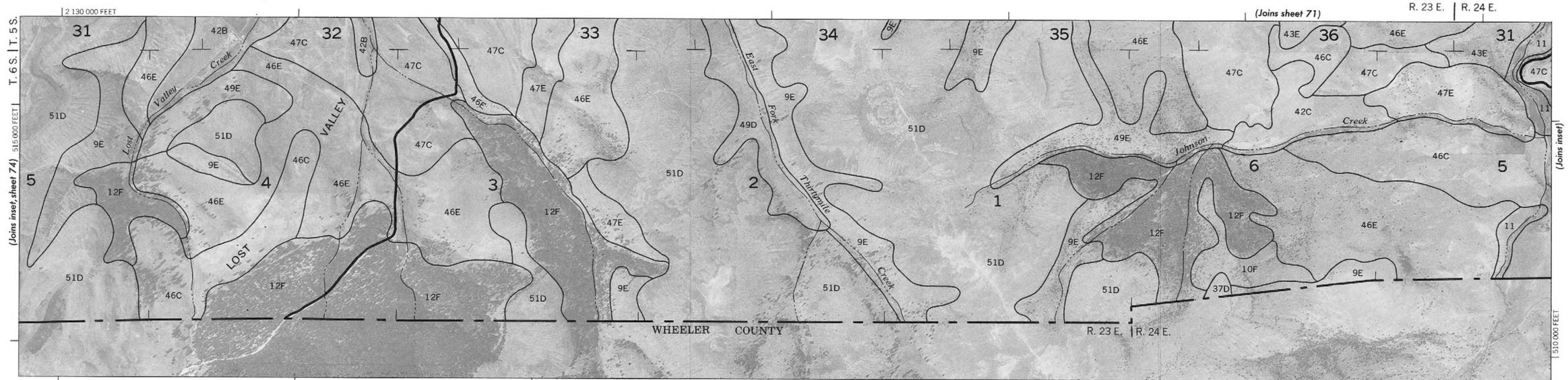
N



4000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000